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Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

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Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVIII. 114 Liberty Street, New York, January, 1915. No. 1

Type of Postal Car for the Northern Pacific Ry.

While the rapid change of car equipment particularly in passenger service has been one of the leading features of construction work during the past year, there has been little of a kind that time. Among others it may be noted that the all-steel postal cars have reached a degree of perfection that leaves little further to be expected or desired. The accompanying illustra- gant features are immediately apparent. The materials and workmanship are of the best.

It will be noted that the car is equipped with six wheel trucks, the journals

[illegible]

may be classed as distinctly new in form or detail; nevertheless it always is of interest to note some of the cars that have been recently received by some of the [illegible] as indicating the class of equipment that is being put in service at the present tions show exterior and interior views of the all-steel postal car recently placed in service on the Northern Pacific railway and constructed for [illegible] Company. As in all of the company's fine products the substantial and ele- of which measure 5 by 9 inches, with Commonwealth Steel Company's center bearing bridge and furnished with Standard Steel Works' steel tired [illegible] journal boxes.

The car body is designed to carry a

live load of 3,000 pounds in addition [illegible] conditions. The side sills are continuous between end sills and composed of [illegible] x 9/16 ins. angle. Center sills are com- [illegible] plates and one 26 x 5/16 ins. top cover plate. The end sills are 3/8 in. pressed [illegible] securely connected at end to sills and at center to cast steel bumper casting, bumper casting securely riveted to end of center sill.

[illegible] channels, 6.5 lbs. per ft. connected to side and center sills, and the diagonal braces are 3/8 in. pressed channels. [illegible]

[illegible]

Height top of rail to top of [illegible]

[illegible] with one M. C. B. Class "G" and one [illegible] in each gear.

Couplers- Buhoup three stem.

[illegible] LX-1812

[illegible]

Heating System -"Gold" hot water cir- [illegible] & Smith heater.

[illegible] with storage batteries.

[illegible]

way right-of-way section of the bridge is 19 feet wide, while on each side is a 12 [illegible]

French Railway Employees.

The number of employees in the latest [illegible] 171,240. These were divided as follows: Nord, 29,451; Est, 21,775; Orleans, 23,-814; Paris, Lyons and Mediterranean, 40,090. Midi, 14,497; State Railways, 40,-150; Ceinture, 1,463. Of the total numbers, 11,799 were drivers and 13,891 fire- [illegible] Shunters, pointsmen, etc., numbered 41,-7[illegible] and the like amounted to 4,139. Permanent-way men, 42,406; gatekeepers, 2,270, and signalmen, etc., 3,1[illegible]4. In addition to [illegible]

[illegible] RAILWAY

built-up body bolsters are used, each consisting of a 5/16 ins. web plate, two [illegible] ins. bottom angles, 10 x 1/2 ins. top and bottom cover plates extending from side sill to side sill. The flooring consists of yellow pine laid diagonally for lower course and rift sawed maple laid longitudinally for upper course. The inside lining is Poplar and the ceiling 3/16 in. Agasote. Three ply Salamander Keystone Hair insulation is used throughout. The cars are equipped with eight sets of Automatic Ventilators type S-4.

[illegible]

Length inside finish [illegible] 60 1

[illegible]

New Type of Bridge on the Big Fraser River.

[illegible] big Grand Trunk bridge at Prince George, [illegible] the Fraser river. The lift span is 100 feet long and instead of swinging like most bridges, it lifts straight in the air. This is accomplished by electrically run ma- [illegible] weights of concrete. The arrangement is [illegible] ton and automatically the machinery is placed in motion which opens the safety lock, closes the six protection gates on the bridge and lifts the 100 foot section to a height of about 30 feet above the level of the floor of the bridge. This bridge over the Fraser river is also one of the longest steel bridges in the Dominion, being 2,654 feet from bank to bank of the river. There are twelve steel spans and the lift, and fourteen concrete piers were necessary to sustain the weight [illegible]

number of men were returned as "miscellaneous." The Paris, Lyons and Medi- [illegible] other railway in France, and, as might have been expected, it therefore employed the largest number of drivers, who amounted to 2,302. On the other hand, the Nord employed the largest number of firemen, the total being 3,429.

Railroad Courtesy.

President Elliott of the New Haven railroad has issued orders directing superintendents and subordinates to be courteous to the public. "That," says the Utica *Press*, "is as it ought to be, and when you come to think of it, it is the way it is on most roads. As a rule railroad employees are proverbially polite. [illegible] answer them more courteously. Their patience is tried frequently and sorely, but they usually put up with it good-naturedly [illegible]

Completion of the Magnolia Cut-Off.

The new 12 mile cut-off on the Baltimore & Ohio, between Orleans road, W. Va., and Little Cacapon, was opened last month. The two main lines from Chicago and St. Louis meet at Cumberland, Md., a short distance from the new cut-off. The new line will be entirely devoted to the eastbound freight traffic only, while the passenger traffic will be maintained on the old two-track line along the Potomac river. The eastbound grade is reduced from 0.5 per cent. to 0.1 per cent., and eliminates a grade nearly 3 miles long, where helper locomotives were required. The improvement involved an outlay of about $6,000,000, and necessitated the boring of four tunnels, aggregating a length of over 7,000 feet.

Improved Railway Facilities in British Columbia.

An official report refers to the great harbor and dock improvements that are being carried out at Prince Rupert. Many millions of dollars have been expended there, so that the harbor facilities may be as ample and satisfactory as any on the Pacific coast, Prince Rupert being the western terminal of the Grand Trunk Pacific railway, tapping the new and rich country of the north. The Panama Canal will greatly facilitate the European trade. The railway will be able to ship, without breaking cargoes, to any port of the world, and the almost untouched natural resources of British Columbia, it is said, will find a market abroad for many years to come.

New Equipment on the Rock Island.

The annual report of the Chicago, Rock Island & Pacific has just been issued, and it appears that in the items of new equipment there were 57 locomotives, 70 all-steel passenger train cars, 2050 freight train cars and 2 wrecking cranes received during the year and added to the equipment. The first two railroad leases here mentioned also made additions to the rolling stock, viz., 18 locomotives, 9 passenger train cars and 351 freight train cars, all of which, excepting five pieces, came with the St. Paul & Kansas City Short Line. Thirty per cent. of the cars in passenger service are of all-steel construction. Of the total mileage of passenger train cars, exclusive of Pullmans, 46 per cent. was by cars of all-steel build.

Ventilation of Railway Tunnels.

The Committee on Roadway of the American Railway Engineering Association has submitted a finding to the effect that the most practicable, effective and economical artificial ventilation for tunnels carrying steam-power traffic is to be obtained by blowing a current of air into one end of the tunnel for the purpose of [illegible] diluting and removing, the smoke and combustion gases at the opposite end. As practised in America, this way of procuring ventilation partakes of two mehhods:

(a) To blow a current of air in the direction the train is moving and with sufficient velocity to remove the smoke and combustion gases ahead of the engine;

(b) To blow a current of air against the direction of the tonnage train with velocity and volume sufficient to dilute the smoke and combustion gases to such an extent as not to be uncomfortable to the operating crews and to clear the tunnel entirely within the minimum time limit for following trains.

MINIATURE RAILWAY

Instruction in Railroading.

Mr. R. H. Ashton, first vice-president of the Chicago & Northwestern Railway, has notified President Mr. R. A. Pearson that the company will loan Iowa State College its expensive dynamometer car for the entire winter. This piece of apparatus will be used by students in railway engineering course in making practical tests of the pulling power of different types of engines under different conditions. As far as the railway commission will permit, this car will be operated on the main line of the Northwestern near Ames for the benefit of students.

This piece of equipment gives the college additional facilities for its work along the lines of railway engineering. This with the completion of the new transportation laboratory on the campus, one of half a dozen in the country, gives the college unusual rank among the engineering institutions of the west.

Railroads on Vancouver Island.

in financing new railway construction on Vancouver Island, but builders are now overcoming this. The Pacific Great Eastern has obtained $6,000,000 from the Government, which enables it to push construction work. In all, this island will shortly have about 630 miles of railroad. The Canadian Northern Railroad has about 150 miles of new road scheduled for completion this year, and will later build 100 miles additional. The Canadian Pacific Railway has 50 miles completed and 100 miles nearing completion, and will then have over 300 miles of line on Vancouver Island.

Railroad Construction in Rio Grande Do Sul, Brazil.

Railroad construction is progressing at a steady and satisfactory rate, although not as fast as might be desired. There is an aggregate of 1,489 miles now in operation and about 200 miles more will be opened to traffic before the end of the present year. The Compagnie Auxiliaire de Chemins de Fer, which operated the Federal lines, has replaced the light rails on the main line with heavier ones. More trains are being run and better time is made.

In April last the President of the State published a decree setting forth the plans for the extension of the Government lines, on which work will commence soon. These lines, as proposed, will open up some of the wealthiest lands in the State.

New Canadian Railway.

The Glengarry and Stormont Railway, connecting Cornwall with St. Polycarpe Junction, on the Canadian Pacific Railway, is expected to be in operation at the beginning of 1915. The total cost of the line is given as $875,000. Nearly all the construction material was purchased in Canada, with the exception of two steam shovels costing about $10,000, a steel water tank costing $4,000, and $3,000 worth of dumping wagons, which were bought from United States companies. The rolling stock, to consist of about 4 engines, 30 passenger coaches, 60 freight cars and 20 construction cars, is either to be purchased or to be supplied from the equipment of the Canadian Pacific Railway.

Safety on the Chicago & Northwestern.

The annual report of the Chicago & Northwestern reveals the fact that during the year ending June 30, 1914, it carried 33,389,428 passengers over its line without a single fatality to a passenger. The Chicago & Northwestern has over ten thousand miles of road, and the fact that its passengers during the year numbered about one-third of the population of the United States, without a loss of life among them, shows that this company has reduced railway service to a science, practical and safe. The Chicago & North-

start the safety-first movement in this country and has done its share to spread the good work broadcast.

Railways and the War in Europe

The appalling magnitude of the European war has drawn attention to the important part played by the railroads in the struggle. Not only in the rapid transportation of troops and munitions of war, but in the ever-varying strategic movements of the forces, railroads are of more significance in the great dramatic tragedy than rifles are. The destruction of the railroads by the armies making retirements and the rapidity of the repairs made by advancing armies also shows how carefully considered the means and methods of destroying or rebuilding railroads and their equipments have been made in advance by the contending powers. To hold a railroad is of more strategic value than holding a city. In this regard it is highly probable that the network of railroads in Belgium has contributed largely to the ruin of that country, and aided in the rapid advance of the destroyers, whereas the scarcity of railroads in Poland and East Prussia has doubtless been the chief cause of the slow and undecisive movements in that particular location of the war. There will be some railroad work to be done when the titanic struggle is over.

We present two reproductions of photographs taken on the western theatre of the war. The first shows a partial destruction of a line of communication by the Belgians on a railway running eastward to Brussels, and which would tax the ingenuity of the German engineers to repair. The smoke of the smouldering ruins gives a weirdly melancholy aspe[illegible] scene, and it is pitiful that [illegible] skill expanded in vast const[illegible] [illegible]rk involving much cost and con[illegible] [illegible]so much to the commerce and co[illegible] people, should thus be destroyed in a moment.

[illegible]

The second illustration is even more striking, and depicts with graphic force a sad story of slaughter and ruin. The locomotive [illegible] the wreckage. The bridge was blown-up while the train was crossing, and there was [illegible] the unfortunate men. As will be observed the locomotive almost succeeded in reaching the bank of the river while the cars were entirely submerged, the momentum of the heavy locomotive carrying

R[illegible] BRIDGE IN FRANCE BLOWN [illegible] THE TRAIN WAS CROSSING

[illegible] it through the air a considerable distance [illegible]

Now that the winter is upon us, there [illegible] there was in the months during our civil war, but from all accounts the preparations for a continuation of the struggle are proceeding on a scale unprecedented in warfare, and it is not unlikely that before the end other nations may be drawn into the vortex of battle. America has much to be congratulated on in standing aloof from the questions involved and giving an example of a peaceful government.

The hope of all right thinking people is that out of the dark tragedy good may come, and that in the grand march of civilization another important advance will be made towards that divine day "when the war-drum throbs no longer and the battle flags are furled in the parliament of man the federation of the world."

Mileage of Railways in the War Zone.

[illegible] be [illegible]nished with the mileages of railways in the countries principally concerned in the European war: Austria, 20,7[illegible] miles; Hungary, 2,102 miles; Se[illegible], 974 miles; Belgium, 2,503 miles; [illegible], 31,390 miles; Holland, 2,295 miles (4 [illegible] 11 ins. gauge); Germany, 36,095 miles; Russia, 47,47[illegible] miles. The largest [illegible] during the last decade has been

General Correspondence

Small Tools and Tool Room Proposition.

By A. W. Vestal, Sedalia, Mo.

No doubt we have all heard the old saying, "A good mechanic doesn't need good tools to do good work," which may or may not be true; but it must be admitted that the quality and quantity of work turned out of a railroad shop, very largely depends upon the quality and quantity of its small tools.

While it would seem that the question is important enough to merit the undivided attention of an expert, especially in a shop of any considerable size, yet in many cases we find each department trying to provide for itself independently of the others and of the shop as a whole.

Many of the men in charge of our shops seem unable to realize the importance of the problem and its relation to output and engine repair cost. Many times, no doubt, they are aware that something is wrong, but never seem to have the time, nor the inclination to analyze the situation, and not sure enough of their ground to make a change.

In many shops, little or no system is followed in the maintenance and distribution of tools, while in others, especially in the newer shops, an elaborate system is often in use and a constant effort made to improve its efficiency by the addition of new and up-to-date tools and proper maintenance and handling.

A good way to get a general idea of the tool equipment of any particular shop is to get into conversation with a so-called "Boomer" or traveling machinist. Some of those fellows are constantly traveling about, over the country, and rarely stay in one place very long, consequently what they don't know about the railroad shops of the country isn't worth mentioning.

Ask one of them about some particular shop and he will say, "Yes, that's a 'high-ball' shop, but, say, they sure have the tools to work with"; or "That's a good easy job, but they have no tools." However, it doesn't always follow that a shop well equipped with tools is a "stiff job"—it is only apparently so because there is so little time lost and an extraordinary amount of work turned out compared to a poorly equipped shop, in which an unusual amount of time must be given to a particular job, simply because the proper tools are not provided to prosecute [illegible] advantage.

In the average shop the tool [illegible] tion resolves itself into two general divisions: (1) The small tools that are kept in a tool room and handled by means of a checking system and (2) the tools that are taken care of by the various gangs as a part of their permanent equipment.

The average tool room is probably the most abused department of any shop; it gets the blame for many of the things it doesn't contain and should as well as for many of the things it does contain and should not. It is generally located in some out-of-the-way place, not suitable for any thing else, difficult of access and where the light is poor. I will venture to say that at least [illegible] per cent of

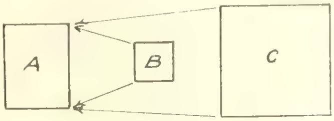


FIG. 1.

the business of the average tool room is transacted with the floor side of the shop, yet we generally find it located on the side farthest from the erecting floor, the last place that even a hillside farmer would think of locating it.

Now suppose we were to regard the question in a diagrammatic way [illegible] Figs. 1 and 2.

A represents the tool room, B its business with the machine shop proper and C its business with the erecting shop. Fig. 1 and Fig. 2 are the same [illegible]

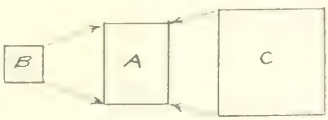


FIG. 2.

that in Fig. 2 A and B have exchanged places. Now if B and C should happen to be, say, 100 yards and 1,000 yards, respectively, and a man had a job contract to remove both to A, he wouldn't be long in deciding which arrangement he would rather tackle for the same money.

A tool room located as in Fig. 1 has another interesting feature in that it illustrates a curious trait in human nature. The average man is a sociable "cuss" [illegible] against the world in general. If he must cross the machine shop in order to reach the tool room, nine times out of ten he will stop to talk to someone or watch the operation of some machine, and probably do the same thing on the way back. It is done unconsciously and doubtless without any intention of "killing time," but it is rather expensive for the company in the course of a year's time when many men are employed.

Again, in Fig. 1 the tool room A is often so placed that it can only be approached from one side, while in Fig. 2 it is accessible from four sides, a decided advantage, as a glance at the two figures will show.

Some months ago a tool room arrangement was described to the writer which certainly seemed to be ideal. Two tool rooms were provided, each located an equal distance from the ends of the shop, on the dividing line between the machine side and the erecting floor. Each tool room was assigned a certain territory to serve and their equipment was identical as far as possible. This system, while a little more expensive to install and maintain, would undoubtedly be a saving proposition in the end on account of greater accessibility.

As to the internal arrangement of the tool room, accessibility should again, of course, be the first consideration and the stock so arranged that the attendants can place their hands on anything in the shortest possible time.

One rather surprising thing, commonly found, is that a tool room attendant should have to lift a motor or other heavy tool four or five feet off the floor and through a window when an opening at the floor line would enable him to shove it out almost without effort.

A serious mistake is often made in carrying wornout or defective tools in stock to pass out for use in the shop. Tools of that kind are, many times, far worse than useless because it not only requires a longer time to complete a job with them, but the work is poorly done. A tap, for instance, may seem perfectly sound at first glance, but if the teeth are distorted or dull and worn its use would result in a waste of time and a thread that would not be standard size. The place for that kind of tool is in the scrap, as it would soon eat up the cost of a new one in time wasted. On the other hand, many tools are thrown in the discard before their time; for instance, a drill with a bit only one inch long that is not burnt or cracked will cut just as

of cases where a brand new drill had to be broken in order to get one of the proper length for a particular job.

thousand and one things, each of them necessary in carrying on the work of the shop, and its efficiency is in direct proportion to its ability to meet every demand upon it. A mechanic applying to the tool room for a 1-in. reamer only to be told "we haven't any," or "we have one but it's out," or "we have one a little larger or a little smaller," is quite likely to go away muttering, and a man in that frame of mind is not likely to care very much whether the job gets done or not.

The whole question of tool room efficiency resolves itself into the question of the proper quantity and a little more, the proper quality and a little better, every tool of an absolute standard size and a centrally located, easily accessible place to put them.

Jig for Drilling Shaft Hole of Hand Car Wheel Pinions

By F. Wm. Bentley, Jr.

Hand car wheel journal pinions whether they come from the foundry rough cored or solid centered, must be bored or drilled to the standard journal size. If they are bored on the lathe, they must be chucked centrally and a drill first run through them for the tool, or if they are drilled on the common press bed they must be laid out so that the hole will be central with the mesh of the teeth.

The accompanying sketch is descriptive of a drill jig which makes the only finishing operation of the small cast pinion a rapid one. The guide frame

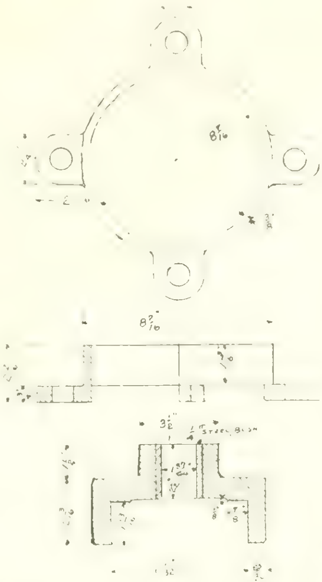
or part of a ring pot casting, and is to

true with the drill. The pinion holder and drill guide B drops down through the guide and over the pinion, and by means of the clamps holds the pinion rigidly central to the bed of the press.

All work necessary in the operation is

to remove and insert the pinions. The drill goes through the pinion after drilling into the center hole of the

tion can be done solely on the drill press, and results in a saving of much



JIG FOR DRILLING SHAFT HOLE OF HAND CAR WHEEL PINIONS.

skilled labor expense. The writer has seen this little device afford excellent results

durability and reliability to a degree that certainly leaves nothing further to be desired.

The War and British Railways.

By Fraser Sinclair, Glasgow, Scotland.

In the September issue of Railway and Locomotive Engineering there is an illustration of a German locomotive for the South Eastern & Chatham Railway of England, as well as some descriptive matter relating to it. It is there suggested that the lower price quoted by Borsigs was the reason for the order going to Berlin, but that I think is scarcely correct. There may have been some slight differences in favor of the Gegel concern but the main reason was, I have reason to believe, that British locomotive builders could not give delivery within the time prescribed. Moreover the Taff Vale Railway, a very extensive system in Wales, was in very much the same pickle, and now find themselves in the unfortunate position of ordering of home engines in lieu of those of which they had been expecting delivery. But of course the home builders and their workmen will reap the advantage. Notwithstanding the undoubted shortage of haulage power on some railways I have heard nothing suggestive of orders going to America. It has to be borne in mind however, that although there is a shortage on some lines due to pressure of business, on others there is an excess of power from dull trade caused by the war, and the results of the war have so far been, that it has resulted in an interchange of facilities in several direc-

there is nothing improbable about such an occurrence. I have heard of the disadvantages to passengers that followed

on the transfer of control of the railways to the War Office, but I did not mention a very considerable benefit. There are a very large number of places in Britain having railway connection by two or more systems. For instance Glasgow and London are connected by three systems and before the war a return ticket was only available on the railway system on which it was issued. Now, a passenger may go by one and return by any one of the others. Most of those tickets are available for six months, and passengers are given facilities to stop off at any stations on the road, but before the war those stoppages were only allowed on the railways on which the ticket was issued. As at present arranged the stoppages may take place, and transfer from one system to another be made, at all points where any two systems abut. Other advantages will be found in the conveyance of merchandise by the shortest routes which was not always possible under private ownership administration. There are many glaring incongruities in the scales of rates for the conveyance of goods in Britain. Two of the most glaring are the sending of farm produce from Normandy in the North of France and from the County of Kent into the London market; and the freight of steel from Glasgow to London. The farm produce can be sent [illegible] over the same railways cheaper than it can be sent from Kent, while steel plates can be sent to America and back to Britain cheaper than they can be sent from Glasgow to London. It is [illegible] none.

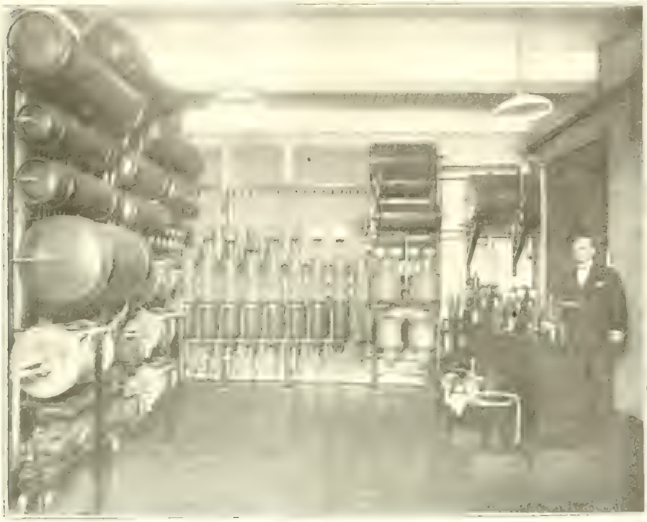
Railway men of some grades in Britain are so poorly paid, and the proposed payment to soldiers while fighting, while maimed, and while dead are so [illegible] them are likely to be better off shouldering a rifle or under the sod than shouldering baggage. There are crowds of men employed as porters, carriage cleaners, and such like who get well under five dollars per week. It is probable that the wives and children of those men who enlist will be better cir[illegible] ing for his country, or dying for his country, than they were before. At the time of writing the payment to soldiers, sailors, and their dependents are miserably inadequate, but a movement is on foot which is certain to result in a considerable [illegible] is not necessary to individualize the various railways; two will give some idea [illegible] railway [illegible] North Western [illegible] thousand men have gone forward, while from the Great Western somewhere between seven and eight thousand are engaged either in actual fighting or in being trained for the struggle. The reason why some are fighting and some not is that perhaps half of the totals are army reservists employed on railways who after putting in some ten or twelve years in the army had retired into private life with a small annual retaining fee for a call on their services if required. Already a good many of those men have paid the last debt of nature in the north of France.

Besides joining the army in large numbers the organized societies of railway workers have entered into a truce to cause no labor trouble during the war. A regular agreement between the representatives of the Government on the one hand, and the men's leaders on the other has been [illegible] will be honorably kept. But there will be plenty of trouble after the war is ended. The lame, the halt, the sick, and the blind are likely to come out of the fight more generously paid than the men who fall back on railway work, and the latter are scarcely the men to accept worse treatment than those rendered unfit for work entirely. As a matter of fact the agreement came as a rather bitter pill to the men. In the [illegible] gone up considerably, but there has been no corresponding increase of wages. However the agreement was loyally accepted and will last for the period of the war.

Some thirty odd years ago, when "the liberty of the subject" bogey began to give way before the need of protection for the men against the greed of rapacious boiler owners, Parliament enacted that boilers should be periodically inspected. Those worthy law makers had reached the conclusion that the discovery of a badly corroded plate was better to be made by inspection than by manslaughter. The law came into operation on the 1st of July, 1882, and when an explosion occurred an inspector employed by the Board of Trade was turned loose on the job to discover who was to blame. Each year a report is prepared in which the causes of the various explosions are [illegible] tabulated. Needless to say the officials concerned exhibit no unseemly haste in the preparation of those reports, and it came as something of a shock the other day to find the report for the [illegible] ready on sale. From that statement it [illegible] free from fatal accident, while of the 20 in which deaths occurred 11 were on land and nine on water. In all 31 [illegible] injured. In this country there is ample provision for the insurance and regular inspection of boilers, yet it is a curious fact that about half of the eighty, 38 to be exact, were free from provision for periodic inspection. In 14 of the cases, involving 20 persons killed and 10 injured, formal inquiries were instituted when it was discovered that two were due to accident: one from water-hammer in a pipe, the other in an oil-separator due to an accident to a workman. In nine cases one person or another was found to blame, and in five instances the person to blame was the owner. It was in France, so far as I can remember, that the salutory rule of a life for a life was enacted when railway trains began to run. The engin-driver was given clearly to understand that if he killed anyone on the line the guillotine would be his portion, and there were no deaths; but every train was like a funeral cortege. That rule applied to boiler owners might do good. In five of the formal investigations no one was found to blame. The average number of deaths per annum over the 31 years was 26.5, so that the year under consideration was 4.5 in excess of the average. The number of deaths per annum varies curiously and the number of fatalities appears to have no relation to the number of explosions. For instance the greatest number of deaths—43—occurred in 1894-95 when the number of explosions was 114, while [illegible] only 12 deaths took place. There has been a steady diminution of fatalities in proportion to the number of accidents, however, from which it can be deduced that the compulsory inspection is doing useful work. In the first five years of the working of the Act there were 223 explosions and 150 deaths, or as near as possible 0.67 death per explosion. In the last five years 482 explosions took place resulting in 100 deaths, or just over 0.207 death per explosion. The great increase of ex[illegible] the last corresponding period is of course due to the enormous increase in the use of boilers in the intervening [illegible]

It may be added that only three of the explosions occurred to locomotive [illegible] a traction engine engaged in road haul[illegible] curiously enough, to engines used by [illegible] then that on all British railways there

was not a single boiler explosion dur-
[illegible]



A Modern Air Brake Instruction Room. Terminal Railroad Association of St. Louis.

St. Louis, Mo.

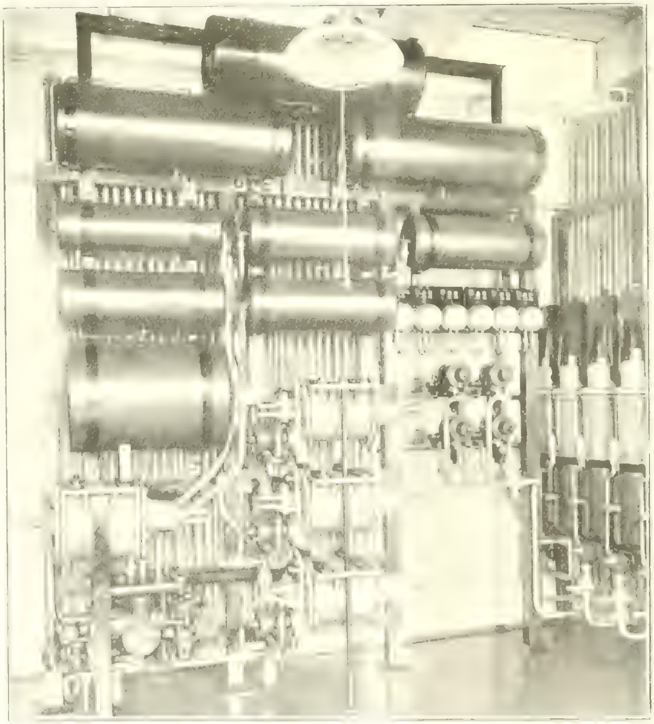
The Terminal Railway Association of St. Louis announce that office and instruction rooms have been moved from [illegible] dious quarters in the Union Station Annex, which is located a short distance south of Union Station train sheds, close to 18th Street Viaduct.

The accompanying photographs show two views of air brake train racks for demonstrating operation of equipment; these racks are composed of two units, one consisting of ten freight car brakes, and the other four passenger car brake equipments, three of which are Schedule "LN" and one Schedule "UC." [illegible] plete train, or separately, when desired to demonstrate either passenger or freight train operation. Each freight car brake is supplied with 40 ft. of 1¼" brake pipe, while 80 ft. of 1" brake pipe is connected to each passenger car brake.

[illegible] which is shown just behind triple [illegible] cylinders, brake pipe, reservoirs, etc., are colored with standard colors representing different pressures, [illegible] part [illegible] at [illegible] 50 and [illegible]

part on colored lithographic charts. [illegible] well as artificial light. A tandem brake equipment, a novel arrangement for demonstrating crossed air and signal hose, well assorted sectional air brake apparatus, sectional draft gear, colored lithographic charts, sectional lubricators and injectors; also a very nicely built up cab model and paraphernalia for demonstrating electrical head light and cab light, of which a Pyle generator operated by air pressure is a prominent feature, are fixtures not shown in attached photographs. A defective triple valve rack, with four defective valves, is shown in the space under the [illegible] gauges connected to various pressures in passenger train rack. A 9½" air compressor with sectional top head operating in tandem furnishes air pressure for demonstration purposes and as the compressor is operated by 80 lbs. air pressure, supplied from power-house, it readily furnishes an [illegible] supply up to a maximum of 140 lbs.

The air pump governor is supplied with three heads, one connected directly to main reservoir, the other two to the "H-6" and "G-6" brake valves respectively. The pulpit equipment consists of an "H-6" and an "S-6" brake valve, feed and reducing valves, a "G-6" brake valve connected in tandem with sectional valve, an "S-3-A" [illegible]



demonstrating feature, four duplex air gauges together with piping and cut-out cocks conveniently located to en-

150 WATT POWER TUNGSTEN LAMP.

able the operator to demonstrate locomotive and train brakes continuously, or in sections best adapted to requirements. The "H-6" and "G-6" brake valve are so connected that double heading features with either valve demonstrating the lead engine can be shown. 13 duplex and 5 single pointer air gauges indicate pressure at various parts of equipment, the neat arrangement of a duplex gauge showing, by aid of a three-way valve, pressure in pressure chamber, application chamber, or application cylinder, of distributing valve. The six duplex gauges mounted above defective triple valve rack show, reading from right to left, Brake Pipe-Brake Cylinder; Supplementary Reservoir-Brake Cylinder; Auxiliary Reservoir-Brake Cylinder; Service Reservoir-Emergency Reservoir; Auxiliary Reservoir-Brake Cylinder; Quick Action Chamber-Quick Action Closing Chamber Pressures. Two complete driver brake equipments, one representing Schedule 6-ET, the other Schedule "A-1," together with one tender brake equipment operating in unison with either driver brake equipment, complete the instruction equipment which is admirably adapted to the requirements of this important terminal, which, besides operating 146 locomotives of their own, handle all passenger equipment of the 22 railroads entering St. Louis. It should be added that the equipment is much appreciated by the em-[illegible]

An Enduring Lamp.

By J. G. [illegible]

The accompanying illustration shows a tungsten lamp of 150 Watt power in single socket—"Benjamin's" cluster. It is mounted on a wooden pole, and is secured with an iron strap to the steel work. The lamp illuminates the end of a swing bridge running across the Ste. Marie Canal for the Canadian Pacific railway at Sault Ste. Marie, Ontario, a fast growing town, and a busy railroad center.

It is remarkable chiefly on account of the long life record of the lamp. It was placed in service on April 15, and burned every day, or every night rather, Sundays included, from dark to dawn, till November 10. Surely this speaks well for the type of lamp, and the reliable condition of the appliances.

Applying Bands to Hose.

By J. A. Jesson.

The accompanying illustration shows a simple tool for applying wire bands to pneumatic and water hose.

The free ends of the band "D" are passed through holes "F," and closed end is placed in groove "G," turning the wrench "B" to the right clockwise, moves the ends in opposite directions until sufficient tension is obtained. Then swing the tool forward until a hook is formed, then turn the wrench to the left until the band is disengaged, cut the wire and hammer down, as in Fig. 4.

Groove "E" is used for forming the closed end of the band. Pin "C" prevents the wrench from working out of body "A."

Fig. 3 shows an easy method of forming the band around the hose, in position shown, pass the free ends through the closed end, hold them stationary and work the closed end over the hose until a circle is formed.

To Prevent Lead from Exploding.

Painful accidents have sometimes been caused by molten lead exploding while being poured. Many workmen have had their patience sorely tried when pouring melted lead around a wet joint to find the lead explode, blow out or scatter from the effect of the steam generated by the heat of the metal. The whole trouble may be stopped by putting a piece of rosin about the size of a hickory nut into the ladle and allowing it to melt before pouring.

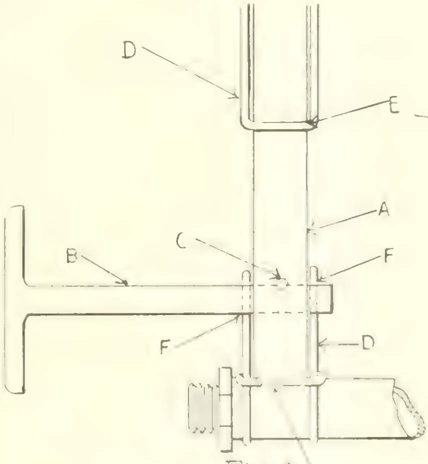


Fig 1

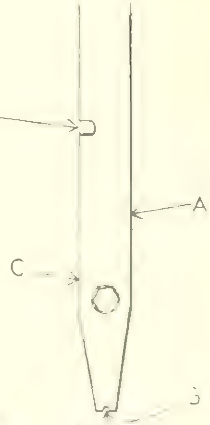


Fig 2

Fig 4

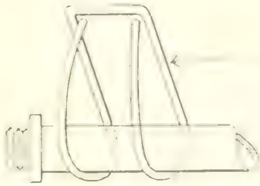


Fig 3

The Mechanical Side of Railroading.

[illegible] of young railroad men ambitious for self-improvement. They meet weekly during the winter months, have papers read on railroad subjects and discuss them. At a recent meeting an address on The Mechanical Side of Railroading was given by Mr. William Schlafge, general mechanical superintendent of the Erie Railroad, and proved peculiarly interesting to all classes of railroad men.

[illegible] reads:

About one hundred years ago the progress of the world in all limes of effort brought about a condition where commerce, particularly inland commerce, had outgrown the known and tried means of transportation to such an extent that an arrest of development was imminent, unless new and adequate methods could be devised to meet the changed conditions of the times.

Then both in the old world, and in the new, the channels of commercial carriage [illegible] and the highways. The latter varied from crude, primitive pathways, through the newer and sparsely settled regions, and of severely limited unit load capacity, to the scientifically constructed roads, of the older and more populous communities, which, designed with that end in view, were correspondingly more economical and efficient.

Steam was receiving recognition as a practical aid to navigation and the day, when its perfected application would sup [illegible] keenly felt, and which called the loudest for relief. But in spite of the efforts of hopeful dreamers and hard working men of mechanical genius and of dauntless courage to adapt steam to the purpose, the day seemed yet far distant when re- [illegible] history repeated itself, just as it does to-day, and almost everybody scouted the idea as an impossibility and an idle dream.

But in every crisis, in every age, some commanding figure rises above his fellows and quietly, calmly takes the burden and meets the problem of the hour. This is remarked with such unfailing regularity [illegible] Providential.

Is there a new continent to be discovered, a Columbus appears. Are the liberties of a nation to be defended and preserved, a Prince of Orange or a Lin- [illegible] Goethals is found to meet the supreme [illegible] seemingly unconquerable forces of nature; and so, in the early part of the nineteenth century, the master mind of Stephenson harmonized and co-ordinated the diverse theories and accomplishments of his contemporary investigators, and gave to the world the steam locomotive as a practical agency of commerce. Nor does it detract from his just fame to concede that another may have a better claim to be considered as the original inventor of the steam locomotive. It is fairly well settled that he made the earliest application of known principles, which produced a workable, successful locomotive of commercial utility. A mere passive academic knowledge of principles, or of truth, is of no avail unless applied. It is application to useful ends that counts.

Thus we see that railroads had their beginning in the fruits of mechanical genius and, after the passing of the century that separates these pioneer efforts [illegible] worthy accomplishments of today, we may still say that the mechanical side of railroading has retained its absorbing interest and its original relative importance.

[illegible] graphically in many ways; but it may be [illegible] told more vividly, more convincingly, more accurately than by contemplating the evolution of the locomotive from Stephen- [illegible] the growth of carrying vehicles from a unit scarcely larger than an ordinary road wagon to the seventy five-ton freight car.

If we are to analyze railroad operation, [illegible] peculiar to itself. On the mechanical side [illegible] roads is the care, inspection and main- [illegible] passenger train cars and 66,000 locomotives, representing an investment estimated at three billion three hundred and fifty million dollars, and calling for an annual maintenance charge estimated at [illegible] peace equal to the Panama Canal, but it would only finance the European war for about ten days.

Were all the cars and locomotives of American railroads coupled together, over two thousand miles of track would be required to hold them. They would considerably more than fill solid the main line double tracks of the Erie Railroad [illegible] single track they would reach from New York to Denver, and it should be remembered, that the end is not yet, for the growth of railways in America is bound to continue for a large number of years [illegible]

Mr. S. M. Vanclain on Locomotive Development.

There have been few people connected with locomotive designing whose expressions concerning lines of progress and improvement have proved so sound as those of Mr. S. M. Vauclain, general manager of the Baldwin Locomotive Works. One of Mr. Vauclain's latest utterances was concerning the centipede locomotive built for the Erie Railroad [illegible] when he said:

"This type of locomotive would never have been suggested, however, were it not for the fact that we are now able to feed a locomotive boiler any amount of coal up to its capacity to burn it. Thus the human equation heretofore preventing the use of large power units has been overcome, and it is my belief that we are just beginning to enter the field of large power units for freight service of the trunk lines of this country. If it can be proven that we can operate locomotives of 150,000 pounds tractive effort, with the same engine crew as heretofore and with less physical exertion on the part of the fireman than with the locomotive of only 50,000 pounds tractive effort, it would appear reasonable that such units of [illegible] railroad companies but by the employees as well."

President Wilson on College Education.

President Woodrow Wilson previous to his election to the high office he now fills was a professor of Princeton University. His estimate of the value of a college education ought to favor the college side, yet he is on record as saying: "A man who takes a course of four years of social life at some university, has thrown away four years of that natural power to work which [illegible] progenitor Adam."

Had to Have His Smoke.

Reports from the warring armies tell of the passion for smoking that there is in the trenches, but the trenches are not the only place where the craving is felt. It is told of a British wagon driver that, although laden with ammunition, he could not forego his smoke, and proceeded to light his pipe while the petrol tank at his elbow was being filled. The petrol took fire, the ammunition got g- [illegible] number of people, but none fatally. The writer of the account of this affair states that some of the men of the convoy were arrested by the military police, which, everything considered, was not very sur-

4-6-0 Type of Locomotive for the Southern Railway

There are few types of locomotives that have been more successful on American railways than the ten-wheeled or 4-6-0. With approximately 75 per cent. of the total weight of the engine carried on the driving-wheels, this type is suitable for either passenger or freight service. In some cases driving-wheels of different diameters are used under the passenger and freight engines, while the majority of the remaining details are interchangeable in the two classes. In other cases, where grades and traffic conditions are favorable, locomotives of the same design are used interchangeably in both kinds of work.

Since the introduction of the Pacific type, ten-wheeled locomotives have been retired from heavy main line passenger service on many roads, but they are still used to a large extent for lighter work, and for general service on short roads and branch lines. With the increase in the weight of all classes of trains, they are, in many cases, more suitable for branch line service than locomotives of the American type, which were formerly used almost exclusively in this class of work.

The accompanying illustration represents a ten-wheeled locomotive, recently built by the Baldwin Locomotive Works for the Southern Railway. This engine carries 109,200 pounds on driving-wheels, and can safely be used on rails weighing 60 pounds and over per yard. The weight of the locomotive is evenly distributed, there being 36,400 pounds on each pair of driving-wheels. The tractive force exerted is 25,700 pounds, and the ratio of adhesion 4.25. With 62-in. wheels, the engine is well fitted for general service.

The boiler of this locomotive is of the extended wagon-top type with wide firebox. The boiler center line is 9 ft. 1 in. above the rail, and the height to the top of the stack is 14 ft. 9 ins. The firebox is comparatively short and wide, and the mud ring is sloped toward the front in order to provide a sufficiently deep throat. Saturated steam is used, and the distribution is controlled by balanced slide valves, which are set with a lead of 15/64 in. and are actuated by the Southern valve gear. This motion has been successfully applied to a large number of Southern Railway locomotives.

Among the larger cast steel details used on this engine may be mentioned driving-wheel centers, driving boxes, steam chests and caps, back foot plate and front bumper. The cylinders are lined with bushings of Hunt-Spiller metal, and the main frames and front frame sections are open-hearth, vanadium steel castings.

The tender is carried on cast iron chilled wheels, weighing 625 pounds each. The tender frame is composed of 10-in. steel channels with oak bumpers.

The following are the leading dimensions of this locomotive:

Gauge, 4 ft. 8½ ins.; cylinders, 19 x 26 ins.; valves, balanced slide.

Boiler.—Type, wagon-top; material, steel; diameter, 64 ins.; thickness of sheets, 11/16 and ¾ ins.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Fire Box.—Material, steel; length, 84⅛ ins.; width, 66 ins.; depth, front, 66¼ ins.; depth, back, 54⅛ ins.; thickness of sheets, sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ½ in.

Water Space.—front, 4 ins.; sides, 4 ins.; back, 4 ins.

Tubes.—Material, iron; thickness, No. 11 W. G.; number, 290; diameter, 2 ins.; length, 13 ft. 6 ins.

Heating Surface.—Fire box, 128 sq. ft.; tubes, 2,035 sq. ft.; total, 2,163 sq. ft.; grate area, 38.5 sq. ft..

Driving Wheels.—Diameter, outside, 62 ins.; center, 56 ins.; journals, main and others, 8 x 10 ins..

Engine Truck Wheels.—Diameter, front, 30 ins.; journals, 5½ x 10 ins.

Wheel Base.—Driving, 11 ft. 9 ins.; Rigid, 11 ft. 9 ins.; total engine, 22 ft. 0 ins.; total engine and tender, 50 ft. 0 ins.

Weight.—On driving wheels, 109,200 lbs.; on truck, front, 38,700 lbs.; total engine, 147,900 lbs.; total engine and tender, 240,000 lbs.

Tender.—Wheels, number, 8; diameter, 33 ins.; journals, 4¼ x 8 ins.; tank capacity, 4,600 gals.; fuel capacity, 8 tons; service, passenger.

Engine equipped with superheater.

Improvements in Honduras.

Besides relaying 35 miles of the main line of their banana railroad from Ceiba to San Juan with 60-pound rails and planning the relaying of the entire system of about 100 miles with similar track, Vacarro Bros. & Co., important shipper of fruit through Ceiba, are completing an 800 by 74 foot all-steel train shed at this port. They are also so remodeling two of their transport fleet, the "Yoro" and the "Ceiba," as to increase the capacity of these vessels from 50,000 bunches of bananas to 70,000 bunches. Sailing vessels carry passengers as well as freight and sail under the flag of Honduras.

Importance of Coal Economy

By ANGUS SINCLAIR, D.E.

Third Article.

[illegible]

While waste of heat results from a profuse supply of air to the fire, beyond the quantity required to effect combination of the gases, much greater loss of heat arises from the supply of air being too small. To strike the happy medium is no easy matter, for the conditions of combustion in a locomotive firebox vary so rapidly that a supply of air which would be sufficient at one minute would be wastefully profuse the next. This is not the only feature of combustion in locomotive fireboxes where it is difficult to steer clear of loss. With the best appliances provided that can ever be devised to aid the fireman in his work, there will always be considerable loss of heat, but thoughtful care and developed skill will do much to restrain these losses.

Coal placed in the most unskillful manner in a firebox badly adapted to economical combustion, will burn after a fashion and make steam, but the steam will be generated at great expense, just as it proves very expensive in the long run to operate an engine that is badly quartered or has the cylinders out of line.

[illegible]

Fireboxes designed to burn anthracite coal perform their functions, as a rule, better than those intended for bituminous coal. The principal cause of the difference is that anthracite coal is nearly pure carbon, and the phenomenon of combustion is much less complex than where much hydro-carbon compounds are present. Less air is required to effect complete combustion, and the fire does not form so compactly as in the case of bituminous coal, and the air that passes through the gates mixes freely through the whole body of the fuel, providing the means of perfect chemical combination. The line of improvement likely to be followed in the designing of anthracite coal burning locomotive fireboxes, is the providing of ample grate area so that the quantity of coal to be consumed per foot of area shall at no time be excessive. Several forms of hard coal burning fire- [illegible] in the way of improvement [illegible]

COAL ECONOMICALL[illegible]

Anthracite coal burning e[illegible] form [illegible] motives, and it is continuall[illegible] wing [illegible] the locomotive of the future. [illegible] the [illegible] economically, and without an objectionable quantity of smoke, is a problem of growing importance, and one that no American master mechanic can afford to ignore, although many do so. In searching for the most economical conditions adapted for the combustion of bituminous in locomotive fireboxes, we have to consider the character of the coal, the way it is handled in feeding to the fire, the size of the grate in relation to the heating surface, the means of admitting and controlling air, and the influence exerted on the fire by the draft appliances

[illegible]

The bituminous coal used as fuel for locomotives contains from 4,000 to 9,000 cubic feet of carbureted hydrogen gas to the ton. The quantity of gas varies according to the quality of the coal, but 6,000 cubic feet to the ton may be taken as a fair average. This gas has nearly double the calorific value of the same weight of pure carbon, yet through the defects of firebox construction and errors of firing most of the volatile gases pass away without producing heat, and are known only to the world through their aggressive attributes as smoke producers. Every pound of coal thrown into the firebox produces about two cubic feet of carbureted hydrogen. When this gas is liberated from the pound of coal it leaves, when impurities are deducted, only about .7 of a pound of carbon in the form of available solid fuel. Were the whole of this carbon now to be utilized in steam [illegible] 10,150 thermal units available instead of 14,500 units in a whole pound of carbon. But the cubic feet of carbureted hydrogen weight about .12 of a pound, and when this enters fully into combination with oxygen, it generates 3,240 heat units, which serve materially to increase the firebox temperature.

From these figures it will be seen that the volatile gases constitute nearly one-third of the heat value of ordinary bituminous coal. A firebox that provides the means of burning all the gases in bituminous coal will show the thermal value of the latter to be nearly equal to the best anthracite. The way to do this is to provide the proper means of mixing air with the gas as it is liberated from the coal, maintaining in the meantime a firebox temperature away above the igniting point

[illegible]

When bituminous coal is used for fuel, the firebox of a locomotive acts as a retort for distilling the gases, and it is to some extent the fault of construction if the gases are not made available for steam raising, and when they are not turned to useful account in this way, their presence in the coal is an actual injury, for good heat has to be wasted in the mechanical work of tearing them from the solid to the gaseous condition. When a shovelful of coal is thrown into the firebox, the immediate effect of the charge is to chill the fire, for part of the heat of the incandescent fuel, previously on the grates, is used raising the fresh coal to the temperature of ignition. When that point is reached, the hydro-carbon gases are liberated. If, at the moment of release, or before they reach the tubes, these gases are supplied with their combining portion of oxygen, they yield their high percentage of heat to the fire; if the necessary oxygen does not reach them they pass into the air, having done no good but harm by carrying away the heat that was drawn from the fire to raise them to the point of temperature necessary to change them from the solid to the gaseous condition. If the temperature of the firebox maintained is high, if the coal is fed in small charges and sufficient air be present above the incandescent fuel to supply oxygen to the hydro-carbons liberated from the coal, there will be little chilling effect from the charges of fresh coal, for the coal as it reaches the fire will produce a flame that will supply the heat required for continued gasification. This is the principal advantage derived from maintaining high firebox temperature, firing light and from getting good air in where it is needed. It makes the difference between wasting and saving an important part of the fuel.

Workers in New York State.

It is interesting to learn from the report on occupations just published that in a population of 9,113,614 there were 4,003,844 workers engaged in gainful occupations. Among these were 39,357 boys and 25,737 girls between the ages of 10 and 15 years earning money. The percentage of workers is increasing. Five years ago only 43 per cent. were at work; now there are estimated 51 per cent. of the population working. At the same ratio of increase we will be nearly all working in twelve years more, and consequently be out of mischief, but sometimes there is nothing more misleading than statistics, because with the advance of science there will likely be fewer workers in the undiscovered future.

General Foremen's Department

New and Improved Process of Heading Stay Bolts.

An improvement in the heading of stay bolts has been jointly devised and patented by Mr. Charles P. Vauclain and Mr. John M. Burns, of Philadelphia, and assigned to the Baldwin Locomotive Works, and bids fair to meet with popular approval. As shown in the accompanying illustrations, the method of heading the stay bolt is accomplished by the use of a specially constructed tool that indents the projecting ends of the stay bolts and causes the metal to turn outwardly. This gradual spreading of the end of the stay bolt, while the periphery is confined by the curved portion of the tool, prevents the edges of the stay bolt from splitting and making a defective head.

Usually it has been the custom to use a stay bolt of such a length that the ends of the stay bolt will project beyond the surfaces of the boiler and reducing these projecting portions by hammering to form the heads. This practice frequently causes the projecting portions of the bolt to split, and great care must be exercised in forming the head so that the bolt will have a neat appearance. In many instances, after the head has been formed, the joint must be calked in order to make it steam and water tight. Stay bolts having a central tell tale hole have to be finished with care, as the tendency is to close the hole in forming the head, and the head must be drilled or reamed after the rivet has been completed, which takes time and makes the operation an expensive one.

In the improved process there is no difficulty in properly heading the stay bolts without cracking the head and also without filling the tell tale hole. Fig. 1 is a sectional view of the stay bolt and plate with end of the stay bolt projecting after being screwed into the plate. Fig. 2 shows the design of the tool and the formation assumed by the projecting end of the stay bolt on application of the tool, and when completed the metal that has undergone the spreading process fits tightly against the plate of the boiler. The displacement of the center of the stay bolt does not extend beyond the outer face of the plate and, consequently, does not expand the metal of the stay bolt within the screw threaded opening.

When a stay bolt is of the type having a tell tale hole opening, as is shown in Fig. 3, the process of heading does not close this opening, but by forcing

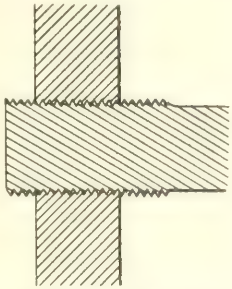


FIG. 1. SECTIONAL VIEW OF STAYBOLT.

the metal from the center outward keeps the center open at all times, making it unnecessary to re-drill or to

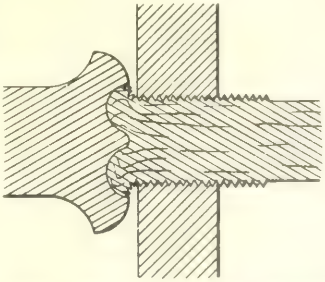
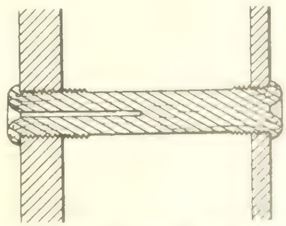


FIG. [illegible]

ream the stay bolt after the head is finished.

It may also be added that the formation of the stay bolt head under the new process is more likely to be durable [illegible] the sheets, as the thicker central formation of the head under the old process is more apt to be burned away than the indented formation of the head under the new method. Tests already made have shown the element of durability in a marked degree, and official reports in regard to this new method of heading stay bolts may be expected at an early date.



[illegible] TALE HOLE.

Fourth Annual Report of the International Railway General Foremen's Association.

We take much pleasure in calling particular attention to a volume containing the Tenth Annual Report of the International Railway General Foremen's Association which was received several months ago and reflected much credit upon Secretary Hall for the prompt manner in which it was published and the admirable manner of its production. The volume contains 192 pages, excellent in printing and noted for correctness in the text.

The report comprises three reports of committees and two subsidiary papers, all of which dealt very thoroughly with the subjects treated and were very exhaustively discussed by the members. The opening address of President W. W. Scott was unusually valuable and contained suggestions for the betterment of the association that cannot fail to prove beneficial if carried out. Among the suggestions made was one "that the number named on committees be increased to ten members and that their selection come from widely separated territory, in order that all data due to climatic or any other unusual conditions may be observed and noted." We think that suggestion might profitably be followed by all other mechanical associations.

The several reports are so exhaustive, that we cannot begin to discuss them, but in many instances the minor subjects make good reports in themselves. Looking over the extensive field of reports from mechanical associations, we cannot think of one that will afford more profitable study than the Tenth Annual Report of the International General Foremen's Association.

At a recent meeting of the Executive Committee of the International Railway General Foremen's Association, it was decided to hold their 1915 convention at Hotel Sherman, Chicago, July 13-16, inclusive.

Catechism of Railroad Operation

[illegible]

Third Year's Examination

[illegible]

Q. 123. What [illegible] if the link [illegible] was broken?

A. [illegible] the link at the desired point of cut-off to handle the train, remove the broken parts necessary and proceed.

Q. 124. What [illegible] if the lifting arm [illegible] broken?

A.—Block the link at the desired point of cut-off [illegible] handle the train, remove the broken parts necessary [illegible].

Q. 125. [illegible] taken, when you have one link blocked up for broken saddle pin or link hanger?

A.—You must guard against reversing the engine, without first changing [illegible] reversed without placing the link to the same position the good side would be after reversal, you would have one side working against the other, and if reversed while in motion might cause [illegible] abled side blocked at, unless you know that the lifting arm will clear the head of link on disabled side.

Note. To get the proper length of block to place on link block to hold link up to the desired point of cut-off on the disabled side, place the reverse lever at point in rack where you will want to work engine the hardest to handle train, cut the block to fit on top of link block in good side and place it in link on disabled side.

[illegible] the lever below point at which you have disabled side blocked, put block in quadrant.

Q. 126.—What would you do if the tumbling shaft breaks?

A.—Where the construction of engine will permit, place bar across top of frame under the lifting arms and lash it there, also lash the lifting arms to the bar. Where this is not possible it [illegible] at the desired point of cut-off by placing block on top of link block under the head of links.

[illegible] in both links would be liable to cause further damage.

Q. 127.—What would you do if the reverse lever or reach rod breaks?

A.—If vertical arm to tumbling shaft extends up through the running board you can raise the links up to the desired point of cut-off and block the vertical arm in that position in slot in running board, otherwise you can support the links (where construction of engine will permit) by placing a bar across top of frame under lifting arms, or by placing block in top of one link only making it carry both links at the desired height.

Q. 128.—What would you do if the vertical arm to tumbling shaft broke?

A. Place bar across top of frame under lifting arms, or block in top of one link only, to hold links at desired [illegible] stops on dead center, and it is neces- [illegible] amount of lead and that the valve has about seven eighths of an inch steam [illegible] move it ahead until mark is flush with face of packing case. With inside ad- [illegible] pull it back until mark is about one inch away from face of packing case.

With outside admission engine standing on back center, mark valve stem at face of packing case, disconnect valve rod and pull back until mark was about one inch away from face of packing case. With inside admission valve, engine on back center, mark valve stem about one inch from face of packing case, and disconnect valve rod and move it ahead until mark on valve stem is flush with face of packing case.

Note. This method will not get the valve exactly in center of its seat but will place it near enough to center to cover the ports, and if you know the [illegible] valve in this manner the amount of lap plus the lead you will get valve on exact center of seat.

[illegible] the valve in center of seat when engine is standing on dead center, if a Stevenson gear, place reverse lever in center of rack, disconnect one eccentric blade from link and move the link until the rocker arm is at right angles to the valve stem, clamp valve there, disconnect valve rod and connect up eccentric rod again.—If a Walschaert valve gear, place reverse lever in center of rack, disconnect lower end of combination lever and move it until valve rod forms a right angle with its upper end, clamp valve there and disconnect radius bar from combination lever, suspend it up and connect up the lower end of combination lever to union link.

Q. 130.—How would you locate side on which valve yoke or valve stem was broken off inside of steam chest?

A. Open the cylinder cocks while engine was in motion and throttle open [illegible] back cylinder cock on the disabled side [illegible]

Note. When valve yoke breaks or [illegible] at the forward end of steam chest, and [illegible] admission port would be wide open, and the inside admission valve would [illegible] open.

Note. On an engine having an outside admission valve if working steam when engine stops, or attempting to [illegible] forward dead center, because the steam in back end of cylinder would move the piston to forward end of cylinder and hold it there. An inside admission valve will some times move to center [illegible] and close port so engine might be moved, but generally it would stop on the back dead center on the disabled side.

Note. In either case after engine had stopped on dead center, you can test for disabled side by opening cylinder cocks, admitting steam and moving reverse lever from one corner to the [illegible] from one cylinder cock to the other it [illegible] and the other valve must be the one [illegible] peculiar rocking motion of engine, [illegible] the other side during half the revolution.

Q. 132.—What would you do if valve yoke was cracked or sprung?

A.—Work reverse lever down at long cut-off, and light throttle, handling full train.

Note.—By working light throttle you reduce the pressure on valve and the friction being less the yoke will hold to complete trip. By allowing the steam to follow piston nearly entire length of cylinder, you will have power to handle train to terminal.

Q. 133.—How would you locate the cracked or sprung valve yoke?

A.—By engine going suddenly very lame and having a heavy exhaust when the crank was passing the front center and a light exhaust when pin was crossing back center, account of valve not giving much port opening at front end of the cylinder.

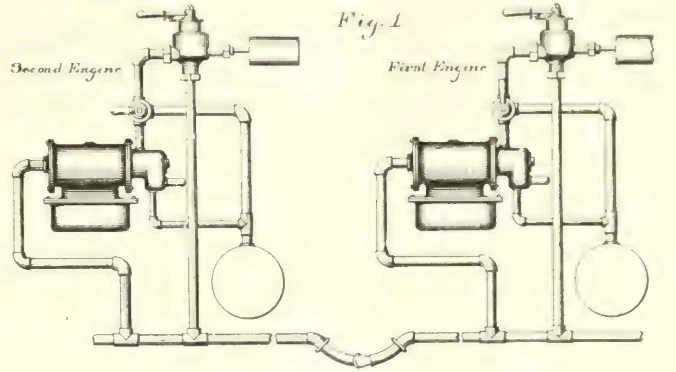
Standing test.—Place engine on top quarter on side you desire to test, have reverse lever in forward corner, open cylinder cocks, set the brakes, open the throttle so as to admit heavy steam pressure to steam chest, pull reverse lever back and note where lever is in relation to center of rack when steam ceases to flow from back cylinder cock. If lever is back of center of rack before valve closes the back admission port it indicates a defective valve yoke.

Note.—When the valve is being moved ahead the stem and back of the yoke will move it squarely on its seat and give the back port full opening, but as valve is being pulled back, the friction will cause crack to open up and valve will move back diagonally on seat and open the forward port but a little, and will not close the back port as soon as it should.

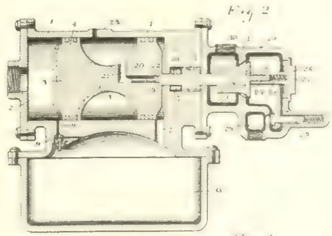
Double-Heading Air Brake Valve.

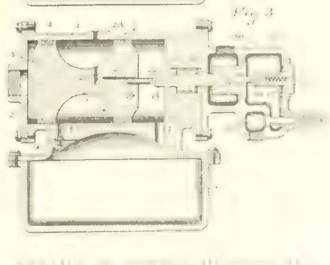
The drawings herewith represent a double heading valve invented by W. R. Davis, road foreman of engines of the T. & O. C. Railway, Columbus, Ohio, and is for the purpose of allowing the use of the air pump of the second engine of double-header trains to assist in maintaining the brake pipe pressure. This valve is automatically operated by the first engineer as to cutting in and cutting out the second engine's pump, giving the benefit of the second engine's pump, which heretofore has been unavailable, due to taking chances of kicking off the brakes when the first engineer applies them. This valve has been tried out on the Toledo & Ohio Central Railway, and it has proved perfectly satisfactory. There are two openings from the valve to the brake pipe and one opening from the main reservoir of the second engine to the valve. The connection to the brake pipe which operates the piston measures half-inch. When the piston is moved to the right it opens the port leading [illegible] moves the valve to the left when a brake pipe reduction is made. This valve seats up against the main reservoir valve and when moved to the right, forces open the main reservoir valve, and allows air from the main reservoir of the second engine to pass into the brake pipe. This air from the main reservoir is reduced 20 pounds below main reservoir pressure by a spring, giving a brake pipe pressure of 70 pounds. In order to place this device on an engine, it is necessary to put a cut-out cock in the pipe leading from the main reservoir to engineer's brake valve, then place the main reservoir connection underneath the cut-out cock toward the reservoir side, running it through the double-heading valve back into the main reservoir pipe leading to the engineer's brake valve, above the cut-out cock. Then, by carrying the engineer's brake valve of the second engine in running position, you have a further insurance of reducing the pressure to seventy pounds by the use of the feed valve of engineer's brake valve.

When the first engineer makes a reduction of five pounds or more, the expansion chamber forces the large piston toward the left, closing the valve leading from the main reservoir of the second engine to the brake pipe. When the first engineer releases the brakes, forcing the air back through the train line, it also moves the piston toward the left and opens the valve leading from the main reservoir of the second engine to the train line, so that at all times the second pump can assist in maintaining the brake pipe pressure, unless there is a reduction made of five pounds, which will automatically cut out the feed from the main reservoir as stated above.



DOUBLE-HEADING AIR BRAKE VALVE IN POSITION.





International Engineering Congress.

In relation to the International Engineering Congress which will be held at San Francisco, Cal., September 20-25, it is announced that while it will be impossible to convene the Electrical Congress owing to conditions abroad, the En-

mally planned. Marked progress is being made in connection with the latter, and valuable papers have already been received from several of the foreign countries and everything points to a successful issue. The volumes which will be received by the subscribers will be a very adequate return to those who subscribe, and the committee are hopeful that the whole engineering fraternity will support the Congress. Full information concerning the Congress may be had from the Secretary of the International Engineering Congress, Foxcroft Building, San Francisco.

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After tirelessly protracted consideration, the Interstate Commerce Commis- [illegible] the Eastern District, subject to a few exceptions. We hope this marks the dawn of a better day for railroad interests, and [illegible] of the Interstate Commerce Commission to act more fairly towards railroad property than it has done in the past. The deci- [illegible] in the financial soundness of the transportation business of the country, which is [illegible] with proper railroad facilities. [illegible] they were not likely to receive the means of transportation they need while conditions existed that were calculated to drive away capital from railroad construction. The enterprise of capitalists who were willing to invest their money in railroads has been the making of this country, and its continued development depends largely upon the encouragement given to capital to continue supplying the necessary funds.

A very considerable part of the depression of business from which the country is suffering is due to the reluctance of capital to provide the means of railroad betterment which has affected many other interests. Builders of railroad rolling stock and other operating machinery are receiving no orders, consequently their help is idle, improvements on road beds and track that were going on so vigorously a few years ago are suspended and the army of idle hands increased because railroads have been deprived of the means whereby the enterprises could be paid for.

We hear people ignorant of financial knowledge calling for railroad companies to provide themselves with resources for carrying out improvements, by passing dividends, a plan that would bring suffering to thousands, at the same time ruining the credit of the companies. As sensibly remarked in a recent issue of the *New York Commercial*: "Railroad financing is complicated by laws that have nothing to do with railroading except indirectly as in the case of these savings bank laws. The Erie Railroad does not pay dividends and cannot borrow money to good advantage. [illegible] double-tracking and otherwise improving its right-of-way from New York to Chicago. It cannot buy a full equipment of steel cars at the same time. If the Erie could borrow two hundred million dollars on fair terms it could employ an army of men, buy vast quantities of rails, cars and other equipment, put itself on a paying [illegible] within five or perhaps three years. Every- [illegible] Erie illustrates the results of lack of credit.

"Let us hope that hereafter Congress and the Interstate Commerce Commission will give due consideration to the needs of the railroads and treat their claims on their merits. This is the will of the people of this country. When the Interstate Commerce law was passed the sole desire of the public was to check favoritism. The rate did not matter as long as all shippers paid the same rates and all localities received the same treatment. One of the chief objects of the men who fought [illegible] that those in control of certain railroads [illegible] of the companies' treasuries. In time this law, framed to increase the earnings of the railroads, was twisted into an engine for their impoverishment. Its prime interest was to protect the railroads from the unjust demands of big shippers, but it has been so administered in practice as to give the shippers the power to fix the rates. When the railroads in the last three years were compelled to pay higher wages, to comply with full crew laws and to elevate or depress their tracks at great expense to comply with State laws they reached the limit of endurance. The New Haven was forced to spend probably sixty million dollars in changing tracks and has not yet done all that the letter of the law demands, but, by irony of fate, its power to borrow money for such work has been destroyed by the savings bank laws of the very States in which the construction work was ordered.

"Our railroads are our greatest material asset. They are the arteries through which the life blood of our domestic trade courses. Our national health depends on them, and we can only keep them in working order by nourishing them. Government regulation of a constructive character is perhaps necessary, but not government restriction of their proper enterprises."

The railroad companies have been carrying out heroic measures to reduce the cost of transportation, but in spite of heavier locomotives and cars of greater capacity the expense of operating continues to increase, owing to the increased burdens put upon it.

In 1900 it cost the railroads 64.62 cents in operating expenses to secure one dollar in revenue. In 1913 the carriers were forced to expend 71.77 cents for every dollar earned. That means the ruinous oppression of all railroad companies. It is no wonder that improvements have been suspended and that the people interested in supplying railroads with material and operating appliances are suffering through want of orders.

Boiler Construction, Maintenance and Inspection.

The committee of the American Society of Mechanical Engineers, on the subject of practical rules covering construction and maintenance of stationary boilers and other pressure vessels, presented a very elaborate and important report on the subject at the meeting in the Engineers' Building, New York, last month.

[illegible] municipalities have in force laws for the compulsory inspection of steam boilers in which are comprised a code of practical rules for their construction and operation, and a number of other States and municipalities either have prepared or are now preparing similar laws for [illegible] all

differ from another in a number of material respects, and unless some relief can be obtained each new law as enacted will differ from all the others. It is a notorious fact that a boiler built in one State may not be shipped into another State, not because the boiler is any less safe in one State than in another, but solely because it does not meet the requirements of construction in both States. But perhaps worse than this is the fact that a State that has no such law becomes a common dumping ground for all the old worn-out and unsafe boilers that are condemned and put out of service by the States that have such laws.

It is practically impossible for boiler manufacturers to comply with all of the various rules of construction embodied in so many different State laws. This condition seriously affects almost every manufacturing interest in the United States. It affects every purchaser of a steam boiler because it increases in an unnecessary and unwarranted manner the cost of boiler construction. It also affects all manufacturers of boiler material because boiler plate and other material cannot be made to uniform specification, and it affects the makers of boiler fittings and safety appliances because they cannot be standardized.

This condition is intolerable, and the committee have worked on the subject with a degree of earnestness and intelligence worthy of so important a subject. They took as a basis for discussion the rules that have for several years worked so satisfactorily in practice in the States of Massachusetts and Ohio, and which have been acknowledged by all interests to be the best rules then in existence, and out of it all the committee's report presents uniform specifications for boiler steel, boiler tubes, safety valves and other attachments, which, if adopted by the various States, would be one of the most important steps ever taken by legislators in regard to boiler construction and boiler safety.

It may be stated that the factors of safety recommended for stationary boilers are somewhat higher than those required by the government for railway locomotive boilers. This is in no sense a criticism of the requirements of the Interstate Commerce Commission, but is based upon the judgment of the committee, that a higher factor should be used for stationary boilers, first, because not every stationary boiler is built in a modern shop under careful engineering supervision; second, because not every stationary boiler is in charge of an operator so skilled as a thoroughly experienced locomotive engineer; third, because stationary boilers are so bricked in and so constructed that their condition cannot so readily be determined, and finally, because locomotive boilers are required by law to be inspected not less than once a month. For these reasons the committee is of the opinion that, while a factor of safety of four affords ample protection for railway locomotive boilers, a higher factor of safety is required for stationary boilers.

In closing it might not be amiss to call attention to the subject of boiler explosions in Great Britain, as commented upon by Mr. A. F. Sinclair in another part of our columns. In his carefully prepared statistics it will be observed that the casualties from boiler explosions in that country are reduced to a very low figure, while from the official reports in this country we learn that from the 1,300 to 1,400 serious boiler accidents occurring every year there are between 400 and 500 persons killed, while 700 to 800 more are injured. These figures, which are official, emphasize the necessity of not only constructing and installing steam boilers and their appurtenances in as nearly perfect a manner as possible, but also the importance of preventing carelessness in their operation and the wisdom of having them inspected at regular intervals by disinterested experts.

Not only so, but what is perhaps of the greatest importance of all is to take the discussion of such work out of the hands of our legislators and place it in the hands of those who, by education and experience, are qualified for the work to the end that human life and property may have that measure of protection to which they are entitled in an enlightened country, where we have often the sorry spectacle of self-seeking politicians quarreling about the law itself, while the people and properties which should be safeguarded are exposed to disasters that might otherwise be avoided.

Machine Shop Conditions.

In his peregrinations about railway machine shops the writer frequently sees drills, wrenches and other tools lying in pits or reclining on floors where they have been left by careless workmen. We say "careless workmen," but when such things come to our notice we make the mental comment, "the foreman is incompetent." We must confess, however, that great improvement in this respect has been effected in the last decade, but there still remains the opportunity for better conditions.

There is a sensible old proverb "learn young, learn fair," which means that the stamp impressed upon youth is readily received and is likely to be lasting. Applying this to orderly habits among workmen, the first thing an apprentice should be taught is the proper care of tools. Often more time is consumed in searching for a tool thrown carelessly aside than it takes to do the job after the tool is found. Every well managed shop has racks or cupboards to keep small tools, when it is not equipped with a regular tool room with a man in charge. We know of no more expensive line of petty economy than doing without a properly managed tool room.

For the benefit of people connected with repair shops away in the wilderness, we wish to say that in almost every railway repair shop of any consequence, there is a tool room and a tool keeper, whose duty it is to look after the tools and check them out to workmen. As a general thing he is also provided with a lathe and other tools needed to effect repairs on the tool equipment. That we say is the practice of well managed shops, but it is surprising how many places are still found where system or good practice is wanting. The Railway General Foremen's Association is ten years' old and it is wonderful the influence for better methods it has promoted and is still pushing forward. Its influence with that of the Tool Foremen's Association will spread the useful knowledge concerning proper shop management that will make loose and inferior practices rare.

A practice that is too rare in railway repair shops is the keeping up of the tool equipment by taking the machines apart for the purpose of cleaning, repairing and adjustment. The time spent in doing such work is amply repaid by increased efficiency, as journals or other wearing surfaces are often found to be grinding, and would without such attention become badly worn before their condition would be noticed.

Belting should never have more than one lacing; should it be necessary to lengthen a belt, it should be skived and cemented. Planer bolts should be squared under the head to prevent the bolt ways in the platen from becoming bruised, the nuts should be of one size and case hardened. Grindstones should be kept trued and never run in water. Polishing on an engine lathe should never be allowed unless it is absolutely necessary.

All machine tools are now made with greater care than they were a few years ago, and therefore should receive greater care. The writer has been in shops where tools from good makers, that were new less than twelve years ago are today worthless for doing good, accurate work. A good lathe properly made ought to last nearly a life time. A badly considered attempt at economy in not a few shops is the making of taps and dies. These things can be bought cheaper from the manufacturers than they can be made by mechanics who are not specialists on that line of work.

There is a tendency among purchasing agents to buy the cheapest tools when requisitions are made for additions to the equipment of a repairing establishment. We know of no practice that is more expensive in the long run. Cheap-

[illegible] great importance that everything in a shop should be kept neat and clean at all times ready for "business," as those upper officials who are looking for results, seldom fail to recognize the in- [illegible]

Air Brake Instruction.

[illegible] readers of the Air Brake Department to the article contributed to the General Correspondence columns, page 432 of the [illegible] Mr. W. [illegible] Turner, [illegible] Westinghouse Air Brake Company. Anyone interested in air brake matters should make a careful study of this letter, as it was not printed solely for the purpose of showing the indorsement of air brake articles which are published in RAILWAY AND LOCOMOTIVE ENGINEERING, but rather to print Mr. Turner's personal opinions as to what air brake instruction should consist of.

Mr. Turner advocates a higher air brake education for railroad officials and devotes a considerable amount of time in conducting a campaign in this direction, and wisely so, because the writer is firm in his conviction that the actual reason for the many deplorable air brake conditions which can be found throughout this country are due, not entirely to the inefficiency of the air brake men employed by the roads, but to a failure in the appreciation of the enormity of the air brake problem, a lack of a thorough prac- [illegible] conditions and a disregard of economics to [illegible] rectly manipulated air brake is an essential, on the part of those in authority and in a position to at least better, if not entirely remedy, troublesome conditions.

[illegible] depressions cannot be construed to represent an excuse for a state of air brake [illegible] proven that an inferior brake equipment [illegible] an efficient one will cost.

As to the article to which Mr. Turner refers, we regret that each issue does not contain one of a similar character, but [illegible] amount of descriptive matter for those of our readers who are [illegible] their study of the air brake and [illegible] whom the article [illegible] and uninteresting, however, be that as it may, Mr. Turner's remarks must stand without question, because among many other things he is the greatest air brake [illegible] no Rome, then without Turner there is no air brake; hence it will be well to remember this remark contained in his letter:

"[illegible] apparatus itself, but contend that this can be of very little value without a knowledge of the principles underlying the performance of an air brake."

In view of the foregoing we can no longer seriously consider the air brake expert of the old school as a factor in the solution of modern braking problems, and by the expert of the old school we mean the air brake man who prides himself upon his ability to call all the ports and passages in the system by letter, and the various valves by numbers, and who has not advanced beyond the knowledge of the effect of weak or broken springs and leaks from exhaust ports. We would rather suggest a study of the air brake that begins with the condition of the rail and considers the energy to be destroyed or work to be done, and the available means for doing it, even though it may not meet with the entire approval of the repairman or the fireman.

Noisy Patent Claims.

"Originality," [illegible] Josh Billings, "consists in stealing with great kaution and kovering up with kare." These sage remarks of funny Josh frequently come to us while pursuing our weekly distraction of reading that humorous publication the *Patent Office Gazette*. That is a representation of current literature which ought not to be read by people with a [illegible] The things described in the *Patent Office* [illegible] scarcely meet with Billings' description. They are not generally "kovered with kare," but are blazoned into "claims" [illegible] tected.

[illegible] the exclusiveness of their right to particular inventions and improvements [illegible] often have the most unsubstantial claims to rest upon. Not infrequently a great noise is started and kept up, by those perfectly conscious of weakness of their boasted rights, in order to frighten away [illegible] ness without testing the strength of the [illegible] and leads to foolish aggression. A new [illegible] machine or mechanical article on which patents have been granted, coming in competition with old and well established manufacturers of a like article needs to [illegible] and penetration, or he may be driven from the field by threats or suits for infringement without having trespassed upon anybody's actual rights or valid patent claims.

Threats of prosecution often accomplish more than the prosecution itself, for purchasers are generally deterred from investing in anything they may be called upon to pay a royalty for using, so long as they can procure something of the same kind without prospects of a demand for royalty. Much injustice has been done by taking advantage of this fact. There is too much inclination among most business men to accept as established facts many things, simply because they have been so often, and so positively asserted without anybody taking pains to deny them. Occasionally some one pulls away the mask, and men wonder why they have been so foolish as to accept so long without investigation a sham for a reality. Patent rights have furnished the material for numerous humbug pretentions.

The humbug claims are not so numerous as they once were. At one time a combination of patent rights sharks was formed that made railways their particular prey. One section of these rogues robbed the railway companies of the United States of millions of dollars on the pretense that they were infringing the Tanner brake patents, which turned out to be no patent at all. The American Railway Association ended this swindle by pushing the case to the Supreme Court of the United States. The same organization arranged for the investigation by experts of all claims founded on patent rights and we hear of no more such claims.

Concern That Advocates Drinking.

There is in St. Louis a concern which calls itself the "Bureau of Co-Operation," its apparent purpose being to advocate habits of drinking intoxicating beverages. Of course the producers of intoxicating drinks are interested in the personal freedom that permits a person to become drunk when he feels that way, but certain employers of labor are interested in [illegible]

The Bureau of Co-Operation seems to made special efforts to reach railroad men with its pernicious literature making trainmen and others believe that putting restrictions upon their bibulous tendencies, is unjustifiable interference with personal [illegible] of valuable property, due to use of intoxicants has moved railway companies all over the world to prohibit the use of intoxicating beverages by their employes, and the traveling public are interested in making rules of this character effective. The literature of the Bureau of Co-Operation ought to be destroyed wherever found.

Modern Locomotive Valve Gears Their Construction and Adjustment

By James Kennedy

The Southern Locomotive Valve Gear.

The latest addition to locomotive valve gears has been introduced on the Southern Railway, and is eminently successful, especially in the important elements of durability, simplicity, efficiency, economy and ease of operation. The illustration shows the general design and details of the gear. It is simple and compact and contains but few wearing parts and angularities. The usual crosshead lap and lead lever connections have been dispensed with, and the lap and lead travel is obtained from the fastest moving part of the eccentric crank travel, which affords quick admission and quick release of the valves, thereby causing increased efficiency and fuel economy, and as a consequence, there has been a corresponding reduction in the weight of the gear, which also means increased efficiency. It has been shown by extensive experiments that if the valves have been properly adjusted at the time that the engine has been constructed or repaired, the gear is so designed as to eliminate the necessity for any further adjustment while the engine is in service.

It will be observed that the links are placed in a horizontal position, and being stationary, the wear is done away with at this point, as the link block only moves in the link when the reverse lever is moved to adjust cut-off or reverse gear. What is known as the slip of the link block is also avoided. A prominent feature of the gear is the ease with which the reverse lever is handled. There is literally no stress or strain upon the lever and reach rod connections. The avoidance of this trouble appeals very strongly to the engineer, as it enables him to adjust the cut-off without any risk of the reverse lever getting beyond his control, and as a consequence, he readily and frequently adjusts the lever to meet the requirements of the situation.

It will also be noted from the accompanying illustrations that the eccentric crank, which is similar to that of the Walschaerts gear, is set at a right angle to the main crank, and for valves having outside admission the eccentric crank leads the main crank pin. [illegible] side admission it follows the main crank pin, that is, when the engine is running forward. The construction of the gearing requires that, while the reverse lever is in the center position of the quadrant, the auxiliary reach rod should be of such length as to bring the link block to the center of the link.

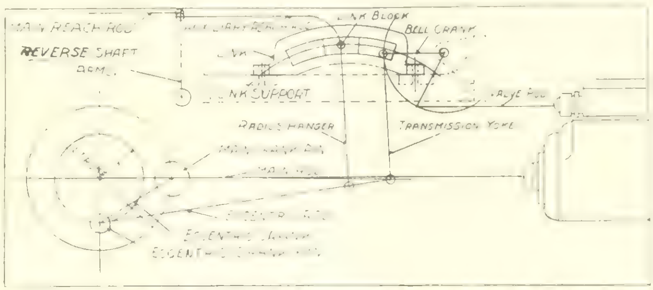
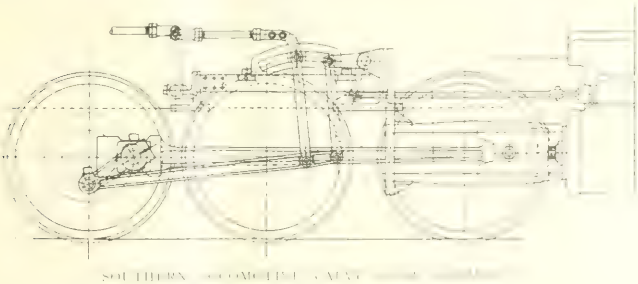


DIAGRAM OF SOUTHERN LOCOMOTIVE VALVE GEAR WITH NAMES OF THE DIFFERENT PARTS OF THE GEAR.

It will also be noted that the eccentric rod has two connections, one of which is attached to the radius hanger from the link block, and the other attached by the transmission yoke to a bell crank which actuates the valve rod. As the two connections are relatively near each other, the result is that when the link block is in the center of the link the movement of the bell crank is reduced to a minimum, and as the link block is moved towards either end of the link the distance traversed by the arms of the bell crank increases, and these parts, with their relative movements, when properly adjusted, have an abiding degree of correctness not surpassed by any other kind of valve gearing now in use.

It is not necessary to describe in detail the remedying of any defect that may arise in the gear. The auxiliary reach rod can be readily shortened or lengthened without removing them to correct any variation in the total valve travel from side to side. The links can be raised and lowered to correct any variation that may arise in the exact opening and closing of the valve, or exact cut-off and release. The two above adjustments will correct any derangement that is possible to occur in this design of valve motion, thereby eliminating the trouble and expense of taking any parts of the gear to the blacksmith's shop to be shortened or lengthened, which avoids the necessity of changing any parts of this design of gear from its standard or blue print dimensions, and those who are at all familiar with other valve gearings will have no difficulty in correcting any slight variation that may arise in the adjustable parts.



SOUTHERN LOCOMOTIVE VALVE GEAR.

Locomotive Electric Headlights.

The Southern Pacific Railroad has been using an electric headlight operated from storage batteries with success. The high efficiency tungsten light makes this [illegible] of 140 candle power rating is mounted in the standard oil lamp reflectors. Each [illegible] is connected to a 300 ampere hour lead [illegible] furnishing energy to the headlight, 3 cab lights and two "blizzard" lamps for 13 hours. The battery is mounted on top of the boiler and is removed when engine is laid up for charging.

Air Brake Department

P. C. Equipment.

the operation of the No. 3-E control valve, as mentioned in last month's issue, we have views of the valve in release and charging, preliminary service, secondary service and service positions, which are of course diagrammatic, and from them an effort will be made to explain the charging of the control reservoirs and chambers and thereafter the effect of a brake pipe reduction upon the valve mechanism.

The pressure chamber of the control valve reservoir stores a volume of compressed air for the operation of the equalizing and application portions. The application chamber is an enlargement of the cylinder or chamber in which the application piston operates. The reduction limiting chamber is an overflow reservoir which is used only after a full

tains compressed air only after full serv-

The equalizing portion at the ... of the reservoir controls the operation of all

... the variations in brake pipe pressure; the quick action portion is used ...

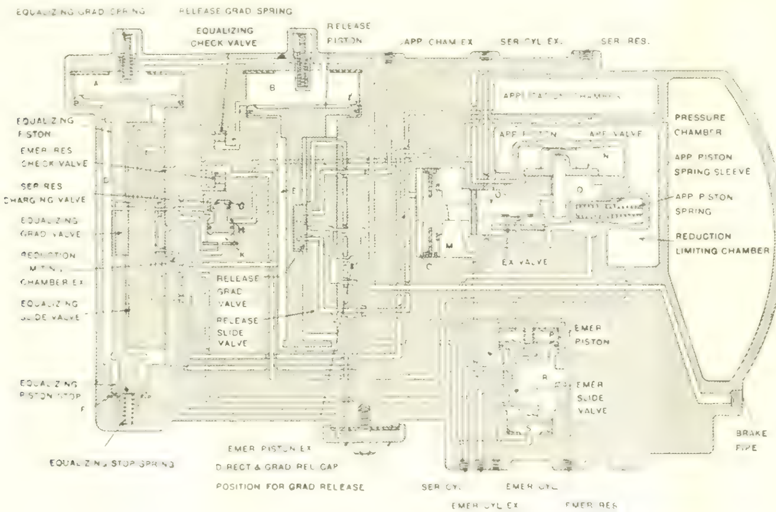
application to other valves in the train in the very shortest possible space of time.

The duty of the application portion is to control the flow of air to and from the service brake cylinder and the emergency portion controls the flow of air to and from the emergency brake cylinder and also hastens the movement of the application portion during an emergency application.

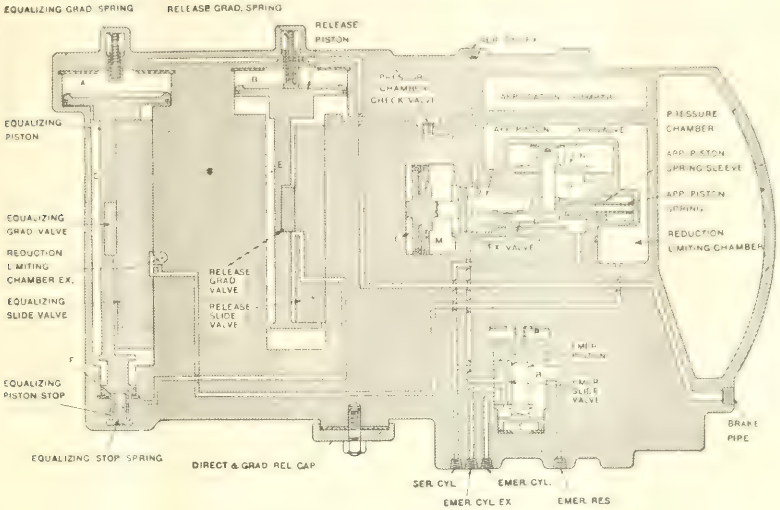
As the control valve must necessarily work in harmony with any previous type of triple valve, it follows that it must be charged up with them, apply upon a reduction in brake pipe pressure and release upon a restoration of the brake pipe pressure.

When compressed air is admitted to the brake pipe, the equalizing and release pistons are forced to their release and charging positions shown, which differs from the normal position in that the spring at the lower end of the equalizing piston, called the equalizing stop spring, is compressed and these pistons assume the positions shown in which air enters the release slide valve chamber through a small feed groove in the release piston bush, and a large flow of brake pipe air passes through the row of ports in the release piston bushing to the under side of the equalizing check valve, lifting it and passing to the equalizing slide valve chamber. From the equalizing slide valve chamber, there is an opening past the graduating valve and through the equalizing slide valve to the under side of the emergency reservoir charging valve, and when this check valve will be lifted by the pressure from the equalizing slide valve chamber, the emergency reservoir will start to charge, and from this same emergency reservoir charging port pressure will flow to the small end of the service reservoir charging valve and still through another port through the graduated release cap and release slide valve to the release slide valve chamber. From the release slide valve chamber another port leads to the large end of the service reservoir charging valve and at the same time branches off to the pressure chamber.

Now as the ports connecting the service reservoir charging valve are so proportioned that the reservoirs cannot charge as fast as the release slide valve chamber, the charging valve will be held in the position shown until all the reservoirs are fully charged to the pressure admitted to the brake pipe. We must at this time admit that this appears quite ... and that the reasons for this indirect flow of air in charging appears somewhat obscure, but we can assure anyone who will follow this up will find that when this and the reasons for it are un-



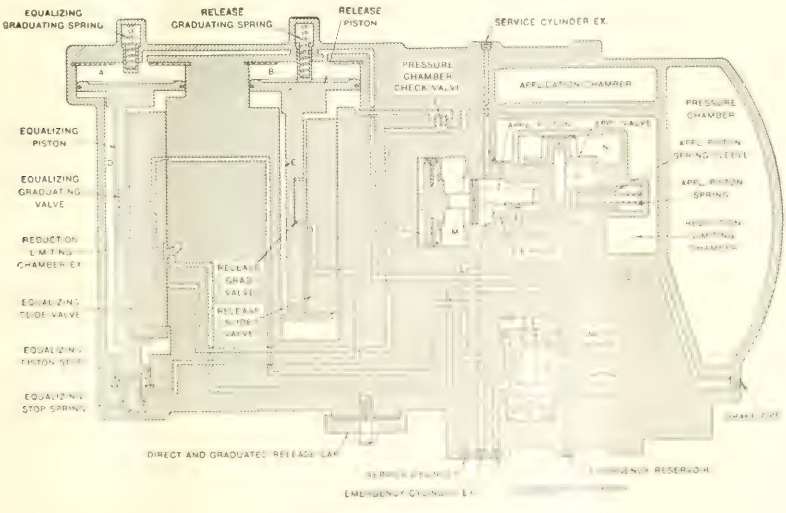
RELEASE ...



PRELIMINARY SERVICE POSITION.

derstood the rest of the control valve operation is comparatively simple.

The idea is to have the pressure chamber charge at approximately the same rate that a triple valve will charge an auxiliary reservoir and when in operation, during release, to create means whereby the pressure chamber can be charged from the emergency reservoir with the service reservoir cut off so that no brake pipe pressure can be absorbed by the control valve during a release of brakes. When the charging is thus completed, pressures in the brake pipe, pressure chamber, service and emergency reservoir, and that surrounding the service reservoir charging valve will be equal; that is, will be governed by the adjustment of the locomotive feed valve, and the application chamber and the chamber back of the application piston will be open to the atmosphere through the release slide valve cavity and the application chamber exhaust port. The reduction limiting chamber will be open to the atmosphere through the equalizing slide valve and the reduction limiting chamber exhaust. The outside of the lower end of the equalizing piston will be open to the atmosphere through the release slide valve and the emergency piston exhaust port. The small end of the emergency piston will be open through the release slide valve and the emergency piston exhaust port. The service brake cylinder will be open to the atmosphere through the exhaust valve of the application portion and the service cylinder exhaust port. The emergency brake cylinder will be



[illegible] is not shown in charging position, pre- [illegible] to the release slide valve chamber during an application of the brake; thus these pressures are to all intent and purpose the same, but the pressure chamber shall not be charged from the release slide valve chamber direct.

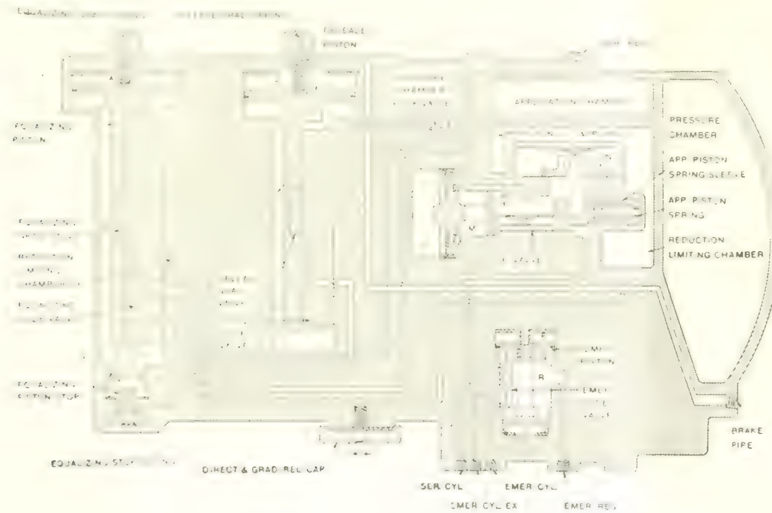
Before proceeding to the action of the valve as a result of a brake pipe reduction or an intended application of the brake, it must be understood that only the service brake cylinder is used for service [illegible] are used for emergency or quick action applications, and that the brake shall not apply on anything less than a definite, or

mit the application chamber pressure which remains constant to again force the application piston to application posi- [illegible]

When a brake pipe reduction is then made, it is effective in the chambers above the equalizing and release pistons, and as the equalizing check valve falls to its seat [illegible] into the brake pipe save through the [illegible] pipe reduction is necessary to cause the release piston to be moved toward appli- [illegible] feed groove and entirely separate the brake pipe from the pressure chamber. A [illegible]

[illegible] position called secondary service, in which a connection is made from the emergency reservoir through the equalizing slide valve to the pressure chamber, which is but momentary and merely compensates for a slight drop in pressure due to the additional pressure chamber space created by [illegible] in other words, the displacement of the equalizing piston is sufficiently great, compared with the volume in the equalizing slide valve [illegible] and at this time the equalizing slide valve also connects the equalizing and release slide valve chambers.

[illegible] maintenance of the pressure chamber from the emergency reservoir must result in [illegible]



4 or 5 lb. brake pipe reduction; therefore some little difference in pressure is required to start the release and equalizing pistons to move and the application piston which is held in release [illegible]

The application portion is identical with the application portion of a distributing valve, being similar in construction and performing the same work; that is, its movement to application position closes the service cylinder exhaust port service and admits service reservoir pressure into the service brake cylinder until brake cylinder and application chamber pressures are equal, when it will be moved [illegible] leakage in the service brake cylinder, the leakage by lowering the pressure will per-

release piston to preliminary service position, in which the release slide valve [illegible] port.

[illegible] reduction the release piston must [illegible] of the equalizing piston is open, to the atmosphere until the release slide valve does arrive in preliminary service posi- [illegible] preliminary service will show that the small end of the equalizing piston is no longer connected to the atmosphere, but instead the pressure is balanced from the release slide valve chamber so that the [illegible] the release piston can also cause the

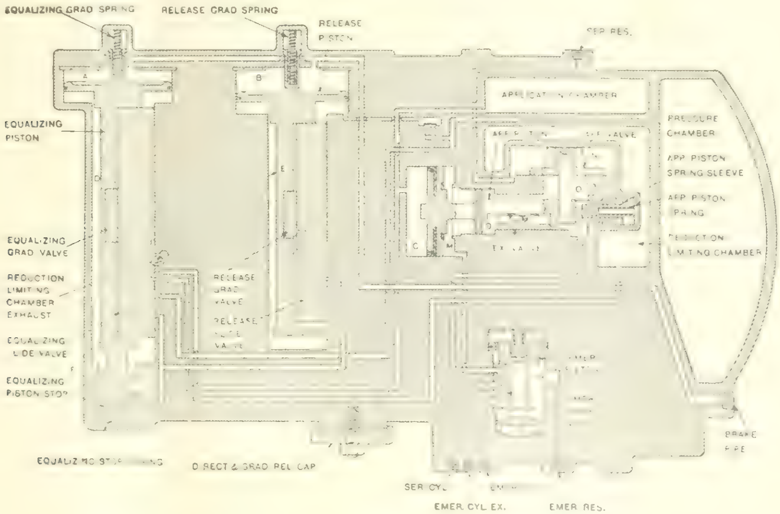
[illegible] positively to service position in which [illegible] When [illegible] position air from the [illegible] release slide valve chambers) will flow [illegible] the end of the equalizing graduating valve and through the equalizing slide valve to the application chamber [illegible] the back of the application piston, [illegible] the application portion to application position and admitting service reservoir [illegible] under [illegible] piston, slide valve and graduating valve control the flow from the pressure chamber to the application chamber,

and that the release piston, release slide valve and graduating valve control the exhaust of pressure from the application chamber to the atmosphere to accomplish a release of the brake. The intent of a brake that will not apply with less than a 4 or 5 lb. brake pipe production is to prevent slight variations in brake pipe pressure from applying the brake when it is not desired, such applications as occur from brake pipe leaks and a defective locomotive feed valve: in fact, it is now well known that, in order to secure a freedom from sticking brakes under modern conditions of service, a brake must release with considerably less differential in pressure than that required to apply it.

It will be understood that the equalizing [illegible] graduating valve control the flow of pressure chamber air to the application chamber in the same identical manner that the equalizing portion of a distributing valve controls the flow from the pressure to the application chamber; in fact, when the control valve was in the experimental stage, the equalizing piston also controlled the exhaust of application chamber pressure, but in order to incorporate all of the desired features it was necessary to divide up the work between the two pistons and their attached slide valves.

The proportion of the pressure and application chambers is such that about 3½ lbs. application chamber pressure (consequently brake cylinder pressure) will be obtained per pound of brake reduction, as a 24-lb. reduction produces 86 lbs. brake cylinder pressure. From this it becomes apparent that service brake cylinder pressure is governed by the proportion of these chambers and not by length of brake cylinder piston travel or size of the service reservoir, and the results attained are that a uniform brake cylinder pressure results on all cars of a train of these equipments regardless of variations in piston travel. From a 10-lb. brake pipe reduction then a 35-lb. brake cylinder pressure may be expected, which, however, owing to a lower total leverage ratio employed, does not produce a greater actual retarding effect than a 22-lb. brake cylinder pressure which could be expected from a 10-lb. reduction on the P. M. brake; consequently braking effect will remain approximately uniform on trains of mixed equipment.

[illegible] ceases before the point of equalization is reached, the still lowering pressure chamber volume will permit the brake pipe pressure, assumed to be stationary, to move the equalizing piston and attached graduating valve toward the lowering pressure and cut off the flow of pressure chamber air to the application chamber. This difference in pressure is much less than that required to move the release piston and its slide valve to release position, therefore, the pressure in the application chamber will be retained and remain constant, while the service reservoir pressure flowing into the service brake cylinder will equal that in the application chamber, when the piston spring will return the application piston to what is known as lap position wherein the service reservoir supply is cut off and the service cylinder exhaust or the exhaust port is held closed by the exhaust valve and the brake cylinder pressure is maintained. This is known as service lap position and the release piston and graduating valve may or may not be moved to lap position with the movement of the equalizing piston and graduating valve, but they perform no functions in either position and a further reduction in brake pipe pressure again moves the equalizing piston to admit more pressure chamber air to the application piston. In this position, a brake cylinder leak will lower brake cylinder pressure; thereupon the application chamber pressure remaining constant will again force the application piston toward application position and admit more service reservoir pressure to the brake cylinder, thus maintaining the brake cylinder against leakage up to the capacity of the service reservoir.



For next month's issue we have an additional number of diagrammatic views, from which other positions of the control valve will be explained.

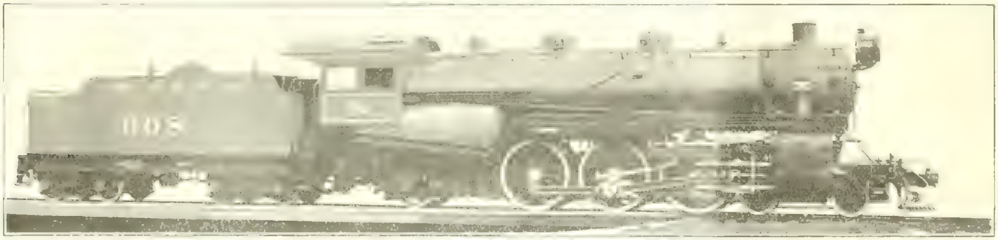
San Francisco Exposition

It is very gratifying to observe that several of the railroads as well as builders of locomotives have already arranged for an extensive exhibit of locomotives at the Exposition. This will include not only the latest types of locomotives, but also some of the earliest types. We will devote all the space that we can to a description and illustration of the exhibit.

Pacific Type of Locomotive for the Delaware & Hudson

Ten large anthracite burning Pacific type locomotives have recently been delivered to the Delaware & Hudson Company by the American Locomotive Company. These are the first locomotives of this type to be used on this road, the heavy passenger service formerly being handled by ten wheelers.

The anthracite burning ten wheelers have a total weight, engine and tender, of 313,900 lbs., the tenders having a capacity of 7,000 gallons and 12 tons. With a driving wheel 69 ins. in diameter, a steam pressure of 200 lbs. and cylinders 21 x 26, they deliver a tractive power of 28,300 lbs. The new Pacifics have a total weight, engine and tender, of 460,100 lbs., the tender having a capacity of 8,000 gallons and 14 tons. With a driving wheel 69 ins. in diameter, a steam pressure of 205 lbs. and cylinders 24 x 28 ins., they deliver a tractive power of 40,730 lbs. This is an increase of 46.6 per cent. in weight and 44 per cent. in [illegible]



[illegible]

A passenger engine necessitates ample boiler capacity. The following comparison of the boilers of the new Pacifics and the older ten wheelers fully demonstrate the advantages of the new engine where sustained capacity is required:

	Pacific Sq. ft.	Ten Wheeler Sq. ft.
Grate area	99.3	84.9
Heating surface—		
Tubes	2627	[illegible]
[illegible]	[illegible]	[illegible]
Fire brick tubes...	40	78
Firebox	277	[illegible]
Total	3896	2662
Superheating surface..	796	——

Comparing the equivalent heating surface, which includes 1½ times the superheating surface, we have 5,090 sq. ft. for the Pacific as against 2662 sq. ft. [illegible]

According to the method of boiler proportioning used by the American Locomotive Company, these Pacifics [illegible] a boiler will have ample steam making capacity if proportioned by this method for 100% but it has been proven that the boiler capacity cannot generally be made too large within the permissible limits of weight. It has been shown by numerous tests, especially by Dr. Goss's investigations, that such increase in boiler capacity makes for considerable economy in the use of fuel and steam. For passenger service, it is advantageous to make the boiler over 100% when possible.

This design was developed by the Mechanical Department of the Delaware & Hudson Company in co-operation with the American Locomotive Company. Interesting details are the Schmidt superheater, brick arch, screw reverse gear, extended piston rods, long main driving box, Economy engine truck, Economy tender trucks, Economy pipe clamps, Economy radial buffer, [illegible] was used in the main frames, driving [illegible] springs.

The following are the general dimensions of this type of locomotive:

Track gauge—4 ft. 8½ ins.; fuel, anthracite.

[illegible] meter, 24 ins.; stroke, 28 ins.

[illegible]

Wheel base driving—13 ft.; rigid, 13 ft.; total, 34 ft. 10 ins.

Wheel base Total, engine and tender, 70 ft. 4¼ ins.

Weight in working order 293,500 lbs.; on drivers, 191,000; on trailers, 55,000, on engine truck, 47,500; engine and [illegible]

[illegible] ing pressure, 205 lbs.

[illegible] ½ in.; sides, [illegible] ins.; sides 4½; back, 4½; depth (top of grate to center of lowest tube), 24⅜ ins.

Crown staying—Radial.

Tubes—Material, charcoal iron; number, 252; diameter, 2 ins.

Flues—Material, hot rolled seamless steel; number, 34; diameter, 5⅜ ins.

Thickness—Tubes, No. 11 B. W. G.; flues, No. 9 B. W. G.

Tube—Length, 20 ft.; spacing ¾ in.

Heating surface—Tubes and flues, 3,579 sq. ft.; firebox, 277 sq. ft.; arch tubes, 40 sq. ft.; total, 3,896 sq. ft.

Superheater surface—796 sq. ft.

Grate area—99.3 sq. ft.

Wheels—Driving diameter, outside tire, 69 ins.; center diameter, 62 ins.

Wheels—Driving material, main, cast steel; others, cast steel; engine truck, diameter, 33 ins.; kind, solid rolled steel; trailing truck, diameter, 45 ins.; kind, cast steel; tender truck, diameter, 33 ins.; kind, solid rolled steel.

Axles—Driving journals, main, 11 x 22 ins.; other, 11 x 13 ins.; engine truck journals, [illegible] trailing, [illegible] x 16 ins.; tender, 8 x 11 ins.

Boxes—Driving, main, cast steel; others, cast steel.

Brake—Driver, American W. N. 3 & B. C.; Westinghouse E. T. 6; tender, Westinghouse E. T. 6, air signal, Westinghouse L.; pump 2-11 ins. Westinghouse; reservoirs, 1-20½ x 120 ins., 1-20½ x 84 [illegible]

Engine truck, 4-wheel swing center [illegible]

Trailing truck—A. L. Co.'s Cole type, outside journals.

Exhaust pipe, single; nozzles, 4 13/16 ins., 4 15/16 ins.

Grate—Style, rocking, 5 1/16.

Piston—Rod diameter, 4¼ ins.; piston packing, gun iron rings.

[illegible] above rail, 14 ft. 9½ ins.

Tender frame Built up of 15 ins. [illegible]

Tank—Style, water bottom; capacity, 8,000 gallons; capacity fuel, 14 tons.

Valves—Type, piston, 14 ins.; travel, 6½ ins.; steam lap, 1⅛ ins.; exhaust cl., 3/16 in.; setting, lead; line and line full gear forward, 9/16 in.; full gear back.

Pacific Type of Locomotive for the Chesapeake & Ohio

Six exceptionally large and powerful Pacific type locomotives have recently been delivered to the Chesapeake & Ohio Railway, by the American Locomotive Company. Having a maximum tractive power of 46,600 pounds, they are believed to be the most powerful Pacific type locomotives ever built. They are not only exceptional in having such a large tractive power but also having a boiler big enough to sustain it, which is so necessary for fast passenger service.

These locomotives have been put in service between Charlottesville, Va., and Hinton, W. Va., a distance of 175 miles. This part of the line crosses three mountain summits: viz., the Blue Ridge, North Mountain and the Alleghanies. To economically handle the through passenger service is a difficult problem. The mountain resorts, among which are the Virginian Hot Springs and the White Sulphur Springs of West Virginia, demand the very best of service and equipment. Trains of ten all steel cars, weighing 674 tons, are a regular daily problem. This has required the regular use of expensive double heading.

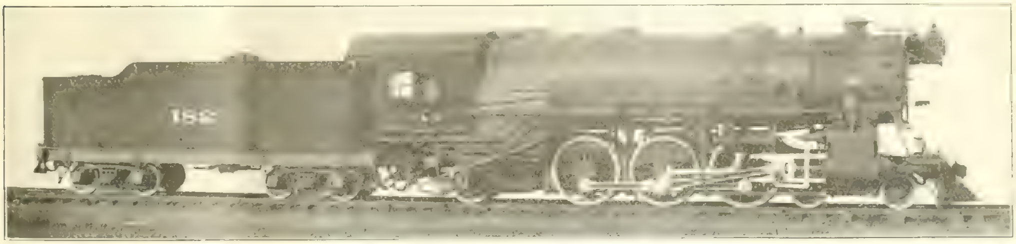
The requirements that must be met in order to make the schedule time on the Clifton Forge division are extremely difficult. West bound from Mechums River to the summit of the Blue Ridge is a continuous uncompensated grade of 75 feet to the mile with curves of 10 degrees and covers a distance of 14 miles. One train of ten steel cars, weighing 674 tons, is scheduled at 22½ miles per hour on this grade, while another train of eight steel cars, weighing 551 tons, is scheduled at 29 miles per hour. From Staunton to the summit of North Mountain, a distance of 13 miles, the conditions are still more difficult. The first 6½ miles contain 4½ miles of up-grade, varying from 75 to 80 feet to the mile and the last 6½ miles is a continuous grade of 80 feet to the mile. The scheduled speed for the first mentioned train is 25¼ miles per hour and for the second 35 miles per hour for this 13 miles. The schedule over the remaining part of the division permits but little time to be made up. These new engines while only having been in service a short time, are very satisfactorily handling these trains.

It is particularly interesting just at this time to note the extent that this railroad has gone in introducing large and powerful locomotives. The Mallet, Mikado and Mountain types now in use on this road, are among the most powerful of their types and have made remarkable reductions in operating costs by increasing the train loads. The achievements of these locomotives, which have more than met the expectations of the railway company, have justified the officials in designing these large Pacifics. No innovations were attempted, but the different factors, fuel saving and power producing features were combined to give as powerful a machine as possible within the clearances.

The exceptional capacity of the boiler warrants special attention. It is of the extended wagon top type. At the first course the barrel measures 83 11/16 inches in diameter outside, while the outer diameter of the largest course is 90 inches. The barrel is fitted with 244 tubes, 2¼ inches in diameter, and 43 flues, 5½ inches in diameter and 20 feet 6 inches long. The firebox is 120⅛ inches long and 96¼ inches wide, having a total depth of 82¼ inches. The depth from the center of lowest tube to the top of grate is 25⅛ inches.

According to the American Locomotive Company's standard system of boiler proportioning, a cylinder 27 inches in diameter using superheated steam having a pressure of 185 pounds, has a cylinder horsepower of 2,427. One cylinder horse power requires an evaporation of 20.8 pounds of steam per hour. To develop full cylinder horse power a total evaporation of 2,427 x 20.8, or 50,500 pounds of steam per hour is required. Boiler tubes 2¼ inches in diameter, 20 feet 6 inches long, spaced ¾ inch, give an evaporation of 8.69 pounds of steam per square foot of heating surface. Boiler flues 5½ inches in diameter, 20 feet 6 inches long, spaced ¾ inch, give an evaporation of 9.86 pounds of steam per square foot of heating surface. Firebox and arch tubes give an evaporation of 55 pounds of steam per square foot of heating surface. The total tube heating surface is 2,933 square feet, total flue heating surface is 1,263 square feet, total firebox heating surface is 255.4 square feet, and total arch tube heating surface is 27.4 square feet. This boiler therefore will give a total evaporation as follows:

Tubes	2,933 × 8.69 =	25,500
Flues	1,263 × 9.86 =	12,450
Firebox	255.4	
Arch tubes	27.4	
	282.8 × 55 =	15,550
Total		53,500



PACIFIC, 4-6-2, TYPE OF LOCOMOTIVE FOR THE CHESAPEAKE & OHIO RAILWAY
J. R. Gould, Supt. of Motive Power. [illegible]

Total boiler evaporation, 53,500, divided by the total evaporation required, 50,500, gives a 106 per cent. boiler. This means that this engine can be worked indefinitely at its full capacity and there will always be a constant supply of steam. To insure a constant supply of fuel to this boiler burning bituminous coal and having a grate area of 80.4 sq. ft., a mechanical stoker had to be applied.

Among the interesting features are a Schmidt superheater, firebrick arch, Street stoker, Raggonet reverse gear, extended piston rods and the long main driving box. Vanadium was used in the main frames, main and side rods, and main rod straps.

The following are the general dimensions of this type of locomotive:

[illegible] coal.

Cylinder—Type, 27 ins. diameter, 28 ins. stroke.

[illegible]

lbs.; on drivers, 189,100 lbs.; on trail-
lbs.; engine and tender, 497,600 lbs.

O. D. first ring, 82 ins.; working pressure, 185 lbs.

crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space front, 5 ins.;

to center of lowest tube), 25⅛ ins.
Crown staying—Radial.
Tubes—Material, seamless steel; number, 244; diameter, 2¼.
Flues—material, seamless steel; num-

Thickness—Tubes, .125 ins.; flues, .150 ins.

4,196 sq. ft.; firebox, 255.4 sq. ft.; arch tubes, 27.4 sq. ft.; total, 4,478.8 sq. ft.
Superheater surface, 991 sq. ft.
Grate area, 80.4 sq. ft.

tire, 69 ins.; center diameter, 62 ins.
Wheels—Driving material, main, cast steel; others, cast steel; engine truck, diameter, 33 ins.; kind, forged steel; trailing truck, 45 ins.; cast steel; tender truck, 36 ins.; kind, forged steel.

x 23 ins.; other, 10 x 14 ins.; engine truck journals, 7 x 12 ins.; trailing truck journals, 9 x 16 ins.; tender truck journals, 6 x 11 ins.

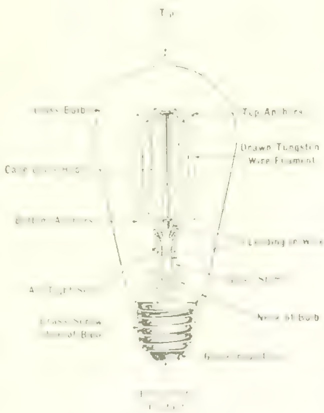
others, cast steel.
Brake—Driver, American WN 3, Westinghouse ET No. 6; brake trailers, Westinghouse ET No. 6; tender, Westinghouse ET No. 6; air signal, Westinghouse Sch. L.; pump, 2-9½ ins. Westinghouse; reservoir, 3-18½ x 72 ins., 1-18½ x 48 ins.
Engine truck—4 wheel swing center bearing.
Trailing truck—Radial, outside journal.
Exhaust pipe—Single, nozzles 5 15-16 ins., 6 1-16 ins., 6 3-16.
Grate—Style, rocking.
Piston—Rod diameter, 4½ ins., piston packing, gun iron ring.
Smoke stack—Diameter, 20 ins.; top above rail, 14 ft. 9½ ins.
Tender frame—Ry. Co.'s built up.

Valves—Type, piston; travel, 6 ins.; steam lap, 1 in.; exhaust cl., ⅛ in.; setting, 3-16 in. lead.

The Edison Incandescent Mazda Lamp

There has appeared, in these columns, a description of the manufacture of the carbon incandescent lamp. Inasmuch as these lamps have been practically superseded by the tungsten filament lamp, especially in the lighting of passenger trains, railroad stations, yards, shops, etc.,

interesting.



be raised determines, to a great degree,

lamp. The question naturally suggested is why the tungsten filament lamp is more efficient than the carbon. The tempera-

ing point of its material and also its evapo-

ency to evaporate than carbon. It can therefore be operated at higher temperatures. The surface of a tungsten filament is also smoother than carbon and there-

section, or in other words, it takes less

greater percentage of energy within the visible spectrum.

process. The pure powdered tungsten was mixed with the binding material squirted through a die, forming a theread which was shaped like a hairpin, which was afterwards treated to remove the binder, leaving it pure tungsten, but of somewhat fragile nature. It was necessary at that time, to mount a number of hairpins in the same lamp, connecting them up in series in order to provide the proper resistance.

The present Mazda lamps have filaments of drawn tungsten wire. The discovery in the Laboratories of the General Electric Company of a process by which the tungsten could be drawn into wire, marked a decided improvement in the Mazda lamp. Pure tungsten powder is compressed under tremendous pressure to such a state as will permit swedging; repeated swedging of the tungsten billet, decreasing its diameter and increasing its length, brings

its being drawn through diamond dies into tungsten wire of the desired diameter. Tungsten is then available in a ductile drawn wire condition, from which it is possible to select the right diameter and

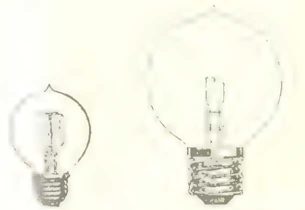
different sizes and for different voltages.

The first step in the manufacture of the

mounting the tungsten wire. The mount

flared at one end to be later welded to the neck of the bulb. At the opposite end of the flare, the tube is welded where the leading in wires pass through to form an

On this stem is welded a piece of cane glass, often called the hub. To this hub are inserted anchors on which the filament



HEADLIGHT

properly disposed, we have what is known as a complete mount.

The glass bulb, as received from the glass factory, has no provision for exhausting at the rounded end, while the neck of the bulb is much longer than required. The bulb is first tabulated by welding a piece of glass tubing at the central point of the rounded end. The

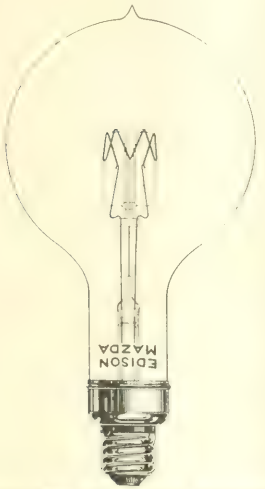
complete mount inserted. The bulb and mount are rotated in Bunsen flames in

bulb to the flare of the stem, making an

air-tight seal; this process is known as sealing-in. The lamp is now ready for exhaust.

The exhaust tube of the lamp is connected to a vacuum pump and the air is sucked out, at the same time the bulb is being sufficiently heated to drive out all moisture. After the bulb is properly exhausted the exhaust tube is cut off by a Bunsen flame, forming the well known tip. The last process in the manufacture of the lamp is basing.

The brass base is fastened to the neck of the lamp by a cement. One leading-in wire is brought out through the brass cap on the end of the base and soldered at this point, while the other leading-in wire is brought out at the side or threaded section of the base where it joins the neck.



MAZDA 1,000 WATT HIGH EFFICIENCY LAMP.

It will be noticed that the cap of the base is insulated from the screw part by a black glass.

The most recent development in the Mazda lamp has been in certain sizes to introduce an inert gas into the bulb, instead of operating the filament in a vacuum. When this is done, the filament is coiled up in a somewhat similar manner to a door spring, this coil being mounted in a compact manner. This new development results in providing lamps of much higher candlepower than ever obtained before, the efficiency in some sizes being as high as ½ w. p. c.

The Mazda lamp, being from three to six times as efficient as the Carbon lamp, its first cost having been reduced to a point that is considered relatively low and because it has been demonstrated that the lamp is strong enough for all ordinary uses, has now become almost universally adopted for incandescent lighting.

Perhaps one of the most interesting and recent developments in the Mazda lamp is the manufacture of a concentrated filament lamp for projection work, such as headlights on steam locomotives. It has been found possible to coil the tungsten wire in a very compact manner and by using lamps of low voltage and high amperes, especially adapted for use with parabolic reflectors, to obtain light source of high intensity and of a very concentrated nature.

Mazda lamps of say 6 volts in 6, 12 and 18 amperes are being very successfully used for steam road locomotive headlights and from the simplicity of their operation seem to be specially ideal for this class of service.

Arts of War and Arts of Peace.

The means of increasing the art of killing has done more to promote the arts of peace than the efforts of any peaceful industry. It is doubtful if the most advanced iron molders would ever have learned to cast a cylinder if their art had not been advanced by casting cannon. Steel made the most effective axes, one of the most primitive implements, but it was only through the art of making swords that the art of making good axes was developed.

The art of making splendidly cutting swords dates from a very early stage of civilization. The Wootz steel of India has been made ever since the practice of reducing iron from its ores was discovered, and no better quality of steel has been produced. The fame of that steel rested principally on its use for the manufacture of sword blades. Those made in Damascus have been most famous. The exquisite temper taken by swords made of that metal enables them in skilful hands to cut bars of metal and fibres of gauze floating in the air.

The story is told that Richard II of England, and Saladin, the great leader of the Moslem hosts, met during one of the Crusades, and the English champion wielded a broadsword so strong that with one blow he cut in two a heavy bar of iron. This did not embarrass the leader of the infidels, for with one stroke of his scimitar he cut in twain a thick cushion stuffed with down.

Anticipated Horrors of Railway Operating.

It is astounding how slowly knowledge permeates through the skulls of some persons who have received a fair share of education. In 1826 when the promoters of the Liverpool & Manchester Railway were striving to obtain the consent of the British parliament to the construction of the railway, there were probably fifty locomotives doing the work of hauling coal-loaded cars in different parts of the British Isles. The speed of these "fire engines," as they were called, ranged from 4 to 10 miles an hour.

Yet in that year of human progress, the Hon. Edward Stanley, a scion of the Earl of Derby, rose in the House of Commons and moved that the bill be read that day six months, equivalent to defeating the measure. In the speech that followed the honorable nobleman undertook to prove that the railroad trains would take ten hours on the journey of less than 40 miles. The enterprise was denounced as a project flagrantly impossible. That the promoters consented to see widows' premises invaded and happy homes smothered with smoke and cinders. What was to become of coach makers and harness makers, coach masters and coachmen, inn-keepers, horse breeders and horse dealers? Was the House aware of the smoke and the noise, the hiss and the whirl which locomotive engines passing at the rate of 10 or 12 miles would occasion? Neither cattle plowing in the fields nor grazing in the meadows could behold them without dismay. Iron would be raised in price 100 per cent., and probably exhausted altogether by this nuisance.

First Principles.

We hear a great deal these days about the desirability of our day schools engaging in the instruction of handicraft operations, but we think that could only be done by neglect of elementary education. If the day schools would devote a little time to instructing the pupils in the first principles of mechanics, the knowledge gained would prove useful in nearly every walk of life. Nearly all mechanics are ignorant of the first principles that apply directly to their calling. The underlying principles of any business or occupation ought to be made a regular study by those engaged in it, so that the road may be open to them for progress and improvement.

Popular Beliefs.

The correct theory of government, said Thomas Carlyle, is to make it as easy for people to do right, and as hard as possible for them to do wrong. Another wise man says that the less interference the people receive from their government the better they are off. The self-seeking politician says: the more laws we can inflict upon the people the more importance they attach to the position of congressman. The people themselves say that the country needs more funerals of politicians, but in some instances it needs more common sense among the people themselves.

Electrical Department

3000 Volt D.C. Electrification of the Puget Sound Lines of the Chicago, Milwaukee & St. Paul Railway.

Plans for the electrification of the first engine division of the Chicago, Milwaukee & St. Paul Railway have now been completed and contracts let to the General Electric Company for the electric locomotives, substation apparatus and line material, and to the Montana Power Company for the construction of the transmission and trolley lines. This initial electrification of 113 miles of main line between Three Forks and Deer Lodge is the first step toward the electrification of four engine divisions extending from Harlowton, Montana, to Avery, Idaho, a total distance of approximately 440 miles, aggregating about 650 miles of track, including yards and sidings. While this comprises the extent of track to be equipped in the near future, it is understood that plans are being made to extend the electrification from Harlowton to the coast, a distance of 850 miles, should the operating results of the initial installation prove as satisfactory as anticipated.

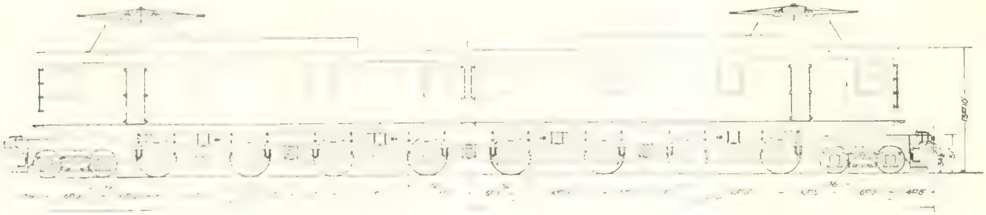
The plans of the Chicago, Milwaukee & St. Paul Railway are of especial interest, as this is the first attempt to install and operate electric locomotives on tracks extending over several engine divisions, under which conditions it is claimed the full advantage of electrification can be secured. The various terminal and tunnel installations have been made necessary, more or less, by reason of local conditions; but the electrification of this road is undertaken purely on economic grounds with the expectation that superior operating results with electric locomotives will effect a sufficient reduction in the present cost of steam operation to return an attractive percentage on the large investment required. If the anticipated savings are realized in the electric operation of the road, this initial installation will constitute one of the most important mile stones in electric railway progress, and it should foreshadow large future developments in heavy steam road electrification. The success of electric operation on such a large scale will, at least, settle the engineering and economic questions that enter into the advisability of making such an installation, and will limit similar future problems to the means of raising the money expenditure required.

Due to the great facilities available and the low cost of construction under the favorable conditions existing, the railway company will purchase power at a contract rate of $0.00536 per kilowatt-hour based on a 60 per cent. load factor. It is expected under these conditions that the cost of power for locomotives will be considerably less than is now expended for coal. The contract between the railway and power companies provides that the total electrification between Harlowton and Avery, comprising four engine divisions, will be in operation January 1, 1918.

The immediate electrification of 113 miles will include four substations containing step-down transformers and motor-generator sets with necessary controlling switchboard apparatus to convert 100,000 volt 60 cycle three-phase power to 3,000 volts direct current. This is the first direct current installation using such a high potential as 3,000 volts, and will be watched with a great deal of interest by engineering and railroad men. The 2,400 volt direct current installation of the Butte, Anaconda & Pacific Railway in the immediate territory of the proposed Chicago, Milwaukee & St. Paul electrification has furnished an excellent demonstration of high voltage direct current locomotive operation during the past year and a half, and the selection of 3,000 volts direct current for the Chicago, Milwaukee & St. Paul was due in a large measure to the entirely satisfactory performance of the Butte, Anaconda & Pacific installation.

The equipment for this road was also furnished by the General Electric Company, and a comparison based on six months' steam and electric operation shows a total net saving of more than 20 per cent. on the investment or total cost of the electrification. These figures, of course, do not take into account the increased capacity of the lines, improvement to the service and the more regular working hours for the crews. The comparison also shows that the tonnage per train has been increased by 35 per cent., while the number of trains has been decreased by 25 per cent., with a saving of 27 per cent. in the time required per trip.

The substation sites of the Chicago, Milwaukee & St. Paul electrified zone provide for an average intervening distance of approximately 35 miles, notwithstanding that the first installation embraces 20.8 miles of 2 per cent. grade westbound and 10.4 miles of 1.66 per cent. grade eastbound over the main range of the Rocky Mountains. With this extreme distance between substations and considering the heavy traffic and small amount of feeder copper to be installed, it becomes apparent that such a high potential as 3,000 volts direct current permits of a minimum investment in substation apparatus and considerable latitude as to location sites if only a direct current system is considered.



TYPE OF ELECTRIC LOCOMOTIVE FOR THE CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

OVERHEAD CONSTRUCTION

The trolley construction will be of the catenary type, in which a 4/0 trolley wire is flexibly suspended from a steel catenary supported on wooden poles, the construction being bracket wherever track alignment will permit and cross-span on the sharper curves and in yards. Steel

supports instead of wooden poles will be used in yards where the number of tracks to be spanned exceeds the possibilities of wooden pole construction. Poles for the first installation are already on the ground and thirty miles of poles are set. Work in this direction will be pushed with all speed and will be completed in the summer of 1915, ready for operation in the fall on the delivery of the first locomotives.

As the result of careful investigation and experiments, a novel construction of trolley will be installed, composed of the so-called twin-conductor trolley. This comprises two 4/0 wires, suspended side by side from the same catenary by independent hangers alternately connected to each trolley wire. This form of construction permits the collection of very heavy current by reason of the twin contact of the pantograph with the two trolley wires, and also insures sparkless collection under the extremes of either heavy current at low speed or more moderate current at very high speeds. It seems that the twin-conductor type of construction is equally adapted to the heavy grades calling for the collection of very heavy currents, and on the more level portions of the profile where maximum speeds of 60 m. p. h. will be reached with the passenger trains having a total weight of over 1,000 tons. The advantage of this type of construction is due partly to the greater surface for the collection of current, but largely to the very great flexibility of the alternately suspended trolley wires, a form of construction which eliminates any tendency to flash at the hangers either at low or high speed. Including sidings, passing and yard tracks, the 113 miles of route mileage is increased to approximately 168 miles of single track to be equipped between Deer Lodge and Three Forks in the initial installation.

LOCOMOTIVES.

The locomotives to be manufactured by the General Electric Company are of especial interest for many reasons. They are the first locomotives to be constructed for railroad service with direct current motors designed for so high a potential as 3,000 volts. They will weigh approximately 260 tons. Perhaps the most interesting part of the equipment is the control, which is arranged to effect regenerative electric braking on down grades. This feature as yet has never been accomplished with direct current motors on so large a scale. The general characteristics as proposed are tabulated below:

Total weight	260 tons
Weight on drivers	200 tons
Weight on each guiding truck	30 tons
Number of driving axles	8
Number of motors	8
Number of guiding trucks	2
Number of axles per guiding truck	2
Total length of locomotive	112 feet
Rigid wheel base	10 feet
Voltage of locomotive	3,000
Voltage per motor	1,500
H. P. rating 1 hour, each motor	430
H. P. rating continuous, each motor	375
H. P. rating 1 hour, complete locomotive	3,440
H. P. rating continuous, complete locomotive	3,000
Trailing load capacity, 2 per cent. grade	1,250 tons
Trailing load capacity, 1 per cent. grade	2,500 tons
Approximate speed at these loads and grades	16 m. p. h.

The Chicago, Milwaukee & St. Paul Railway, from Harlowton to the coast, crosses four mountain ranges: the Belt Mountains at an elevation of 5,768 ft., the Rocky Mountains at an elevation of 6,350 ft., the Bitter Root Mountains at an elevation of 4,200 ft., and the Cascade Mountains at an elevation of 3,010 ft. The first electrification between Three Forks and Deer Lodge calls for locomotive operation over 20.8 miles of 2 per cent. grade between Piedmont and Donald at the crest of the main Rocky Mountain Divide, so that the locomotives will be fully tested out as to their capacity and general service performance in overcoming the natural obstacles of the first engine division.

The initial contract calls for nine freight and three passenger locomotives having the above characteristics and similar in all respects, except that the passenger locomotives will be provided with a gear ratio permitting the operation of 800-ton trailing passenger trains at approximately 60 m. p. h., and will, furthermore, be equipped with an oil-fired steam heating outfit for the trailing cars.

The drawbar pull available for starting trains will approximate 120,000 lbs. at 30 per cent. coefficient of adhesion.

The freight locomotives are designed to haul a 2,500-ton trailing load on all gradients up to 1 per cent. at a speed of approximately 16 m. p. h., and this same train load unbroken will be carried over the 1.66 and 2 per cent. ruling grades on the west and east slopes of the Rocky Mountain Divide with the help of a second similar freight locomotive acting as pusher. Track provision is being made at Donald, the summit of the grade, to enable the pusher locomotive to run around the train and be coupled to the head end to permit electric braking on the down grade. In this case the entire train will be under compression and held back by the two locomotives at this head end, the entire electric braking of the two locomotives being under the control of the motorman in the operating cab of the leading locomotive. It is considered that electric braking will prove very valuable in this mountain railroading; for, in addition to providing the greatest safety in operation, it also returns a considerable amount of energy to the substations and transmission system, which can be utilized by other trains demanding power. In this connection the electric locomotives will have electric braking capacity sufficient to hold back the entire train on down-grade, leaving the air brake equipment with which they are also equipped to be used only in emergency and when stopping the train. There is, therefore, provided a duplicate braking system on down-grades, which should be reflected in the greatest safety of operation afforded and the elimination of a considerable part of breakdowns, wheel and track wear, and overheating with consequent reduction in maintenance and improvement in track conditions.

The electrification of the Chicago, Milwaukee & St. Paul is under the direction of Mr. C. A. Goodnow, assistant to the president in charge of construction, and the field work is under the charge of Mr. R. Beeuwkes, electrical engineer for the railway company.

An Electric Steam Radiator.

One would hardly imagine that an electric heater would resemble a steam radiator, yet a heater of this type has been brought out and is being manufactured by the Electrical Steam Radiator Company, of Portland, Me. In appearance the heater resembles the ordinary steam radiator connected to a central boiler system. In the bottom waterway of the radiator is placed a tube in which is inserted another tube of 3/16 in. smaller diameter. A resistance coil is placed in the smaller tube, which heats up when the electric current is allowed to pass through it. From 1½ to 3 quarts of water are kept in the radiator, this water passing through the larger tube and around the smaller one, when the current is turned on. It takes about 15 minutes for the water to boil into steam. The steam then circulates to the radiator sections, condenses and returns to the pipe and is then turned to steam again. There are no leaks and the small amount of water will last from 2 to 3 months. An automatic device is provided with the heater so that the temperature can be regulated.

Portable Electric Drills.

Portable electric drills are coming into very general use. Types now being manufactured can run on either alternating or direct current. Machines of this type are made for drilling holes in steel up to 0.625 in. in diameter. The weights and speeds vary from 6 lbs. and 2,200 revolutions per minute for 3/16-in. holes, to 18.5 lbs. and 500 revolutions per minute for 0.625-in. holes, and although of only recent introduction they are already coming into popular favor in many machine

Items of Personal Interest

Mr. E. R. Battley has been appointed general foreman of the Grand Trunk, [illegible]

Mr. [illegible] appointed machine shop foreman of the Southern, [illegible]

Mr. W. B. Trow has been appointed general foreman of the Rock Island Lines, with office at Armourdale, Kan.

Mr. G. W. Ristine has been appointed road foreman of engines of the Baltimore & Ohio, with office at Cleveland, Ohio.

Mr. W. H. Burleigh has been appointed roundhouse foreman of the Rock Island Lines at Armourdale, Kan.

Mr. [illegible] appointed locomotive foreman on the Great Northern, with office at Butte, Mont., [illegible]

Mr. F. Kinzel has been appointed general foreman of the Detroit, Toledo & Ironton, with office at Delray, Mich., succeeding Mr. D. Swineford.

Mr. Felix Gagnon has been appointed [illegible] the Intercolonial, with office at St. Flavie, Que., succeeding Mr. J. M. Bordeau.

Mr. A. S. Wright, formerly locomotive foreman of the Grand Trunk Pacific at Regina, Sask., has been appointed locomotive foreman at Biggar, [illegible]

Mr. W. J. Miller has been appointed superintendent of motive power of the St. Louis Southwestern, with office at Pine Bluff, Ark., succeeding Mr. T. E. [illegible]

Mr. E. L. Mauk has been appointed superintendent of motive power of the [illegible] offices at Bainbridge, Ga., succeeding Mr. P. G. Clark.

Mr. A. G. Pierce has been appointed general foreman of the Chicago, Burlington & Quincy, with office at Edgemont, S. D., succeeding Mr. L. L. Brandt.

Mr. D. E. Smith, formerly locomotive foreman of the Grand Trunk Pa[illegible] appointed locomotive foreman on the same road at Regina, Sask.

Mr. T. W. Callahan, formerly master mechanic on the Great Northern at Whitefish, Mont., has been transferred to a similar position on the same road, [illegible]

Mr. J. O. McArthur, formerly assistant master mechanic of the Chicago, Burlington & Quincy, at Caspar, Wyo., has been appointed master [illegible]

Mr. J. Delaney, formerly master mechanic of the Great Northern, at Minot, N. D., has been transferred to a similar position on the same road, with office at Whitefish, Mont.

Mr. G. W. Tamsitt has been appointed acting master mechanic of the Kansas City, Mexico & Orient, of Texas, with office at San Angelo, Tex., succeeding Mr. Charles Woodward.

Mr. A. S. Jackson, formerly superintendent of motive power of the Chicago, Terre Haute & Southeastern, has been appointed [illegible] superintendent of motive power of the Toledo & Ohio Central and Zanesville & Western railroads, and Mr. C. Bowersox, master mechanic, has assumed the duties, the higher office being abolished.

Mr. L. Chapman has been appointed assistant master mechanic of the Chicago & North Western, with office at [illegible] more succeeds Mr. Chapman as foreman of shops on the same road at Chadron, Neb.

[illegible]

[illegible]

[illegible] Mr. J. C. Muir, deceased.

Mr. A. J. Eichenlaub has been appointed general foreman of the Chicago & Eastern Illinois at West Frankfort, Ill., and Mr. O. E. Shaw has been appointed general car foreman on the same road, with office at Danville, Ill.

Mr. A. D. Brice, formerly assistant to the master car builder of the San Antonio & Aransas Pass, has been appointed master car builder on the same road, with office at Yoakum, Tex., in place of Mr. W. T. Cousley, resigned.

Mr. E. H. McCann has been appointed master mechanic of the San Antonio, Uvalde & Gulf Railroad, with office at Pleasanton, Tex., succeeding Mr. J. H. Ruxton, formerly superintendent of motive power, who has resigned.

Mr. S. S. Stiffey has resigned as

[illegible] the *Erie Railroad Employees' Magazine,* is interesting on account of the long period of service rendered by some of the five retired engineers shown in the picture. From left to right the names are: Mr. [illegible] 1845 to 1884; Mr. John F. Demarest, 74, from 1865 to 1902; Mr. John P. Sullivan, 72, from 1859 to 1912; Mr. Cornelius Kent, [illegible] Bell, 70, from 1859 to 1867. Mr. Bell is still in active railroad service, occupying the position of vice-president and general manager of the Morristown & Erie Railroad.

Mr. J. A. Cassady, formerly master mechanic of the Alabama Great Southern, at Birmingham, Ala., has been appointed master mechanic of the Cincinnati, New Orleans & Texas Pacific, with office at Somerset, Ky. Mr. Cas-

sady succeeds Mr. H. B. Hayes, who has been appointed master mechanic of the Alabama Great Southern, at Birmingham, Ala.

Mr. D. C. McCarthy has been appointed traveling engineer on the Denver & Rio Grande, with office at Salida, Col., and Mr. A. G. Titus succeeds Mr. McCarthy as traveling engineers on the same road, with office at Grand Junction, Col.

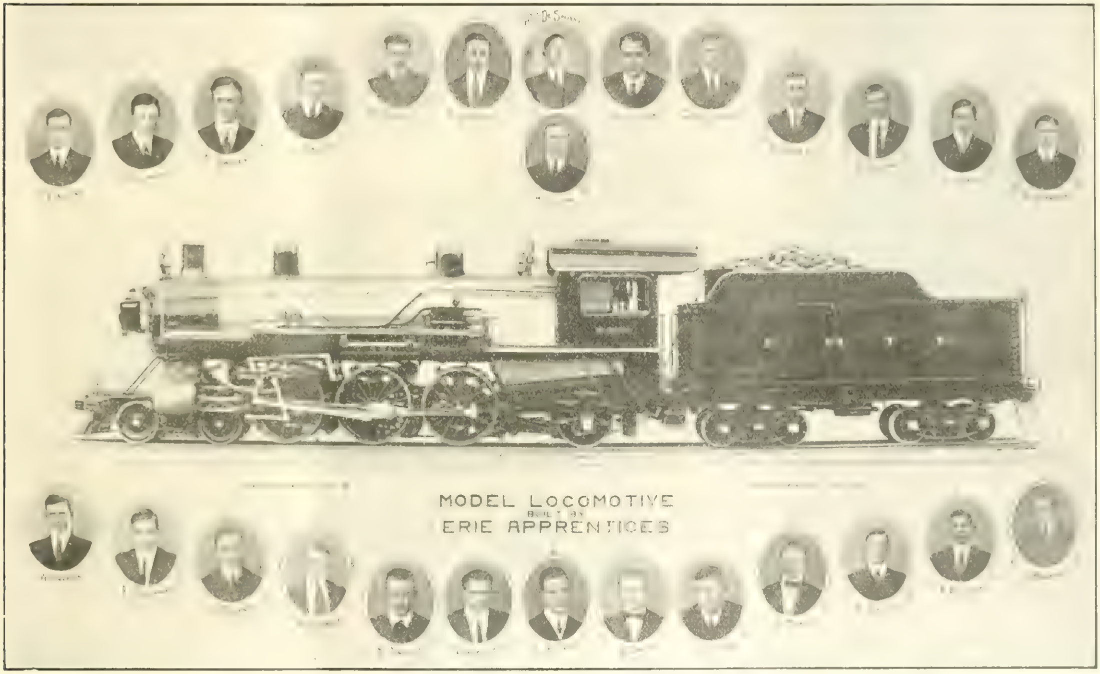
Mr. D. D. Curran, formerly president and general manager of the New Orleans & Northeastern, and the Alabama & Vicksburg, and Vicksburg, Shreveport & Pacific, has been elected president of the New Orleans Railways and Light Company.

Mr. J. F. Leake, formerly foreman of freight car repairs on the Southern, at Costa, Tenn., has been appointed chief joint inspector at Chattanooga, Tenn., comprising the Alabama Great Southern; Cincinnati, New Orleans & Texas Pacific, and Southern, and Mr. J. S. Easterly, formerly chief car inspector of the Southern at Citico, Tenn., has been appointed foreman of the freight car repairs at the Coster shops.

Mr. W. Gillespie, formerly master car builder of the Central Vermont, at St. Albans, Vt., has been appointed mechanical superintendent in charge of motive power and car departments, and Mr. T. A. Summerskill, formerly superintendent of motive power, and Mr. J. E. Fitzimmons, formerly master mechanic, have been assigned to other duties. The offices of master car builder, superintendent of motive power and master mechanic have been abolished.

At the shops of the Erie railroad at Meadville, Pa., 26 apprentices have built a working model of what is known as the K-1 type of locomotive. The total weight of the engine and tender is 812 pounds. The total length of engine and tender is about 7 feet. The engine is an exact duplicate of the large locomotives. In a test of speed it made 572 revolutions per minute. The names and occupations of the apprentices are as follows:

H. Harding, blacksmith; L. Leberman, H. Horth, W. Davern, A. Kuhn, R. Teifer, patternmakers; F. Hermon, I. Dinkeldine, boilermakers; A. Miller, tinsmith; L. Girardat, P. Dailey, J. Davies, W. J. Reuter, G. Fredericks, E. Hines, R. Knapp, W. Scanlon, T. Owens, H. Hermon, R. Nelson, L. Byham, L. Craig, C. Chapin, A. Nashett, P. Leurick, J. Beimer, machinists.



REPLICA OF AN ERIE CLASS K-1 PASSENGER ENGINE, BUILT BY [illegible]

Obituary.

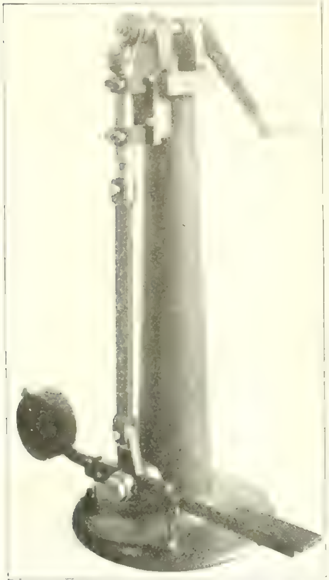
[illegible]

The involuntary retirement from active business, due to impaired health, has for several years taken Charles A. Moore, of the firm of Manning, Maxwell & Moore, from taking active part among the railroad supply men, but the time was when Mr. Moore was a prominent figure at all conventions where railroad supply men exerted themselves as entertainers. The numerous railroad men, of long ago, who enjoyed the whole hearted, genial entertainment which Mr. Charles A. Moore delighted to confer, will be grieved to learn that their friend of long ago passed away last month while at sea on a voyage to Italy.

Charles Arthur Moore was born at West Sparta, New York, sixty-nine years ago, and was trained to commercial business. He made such success in soliciting business from railroad companies that he joined with H. S. Manning & Co. in forming the firm of Manning, Maxwell & Moore, one of the most successful concerns that ever handled railroad appliances. Mr. Moore was an active spirit in a great many social, political and patriotic organizations; he was Chevalier of the French Legion of Honor, and has a daughter married to the Duke of Forlonia, a noble of Italy. Mr. Moore had a peculiarly alluring personality, which made friends wherever he went. He was an intimate personal friend of President McKinley, and accompanied him on one of the presidential tours. He leaves a wife and a grown up family.

Special Machine for Marking Fuse Caps.

A special marking machine for graduating and numbering bevel fuse caps in



MACHINE FOR MARKING FUSE CAPS

one operation has just been put on the market by the Noble & Westbrook Manufacturing Company, of Hartford, Conn., fully equipped with graduating dies ready for the operator to start work. This is an addition to the company's well-known Dwight slate marking machines. This machine, illustrated herewith, is simple in construction, accurate and easy to operate. This means quite a saving to the manu- [illegible] are to be graduated, especially at this [illegible] pressing.

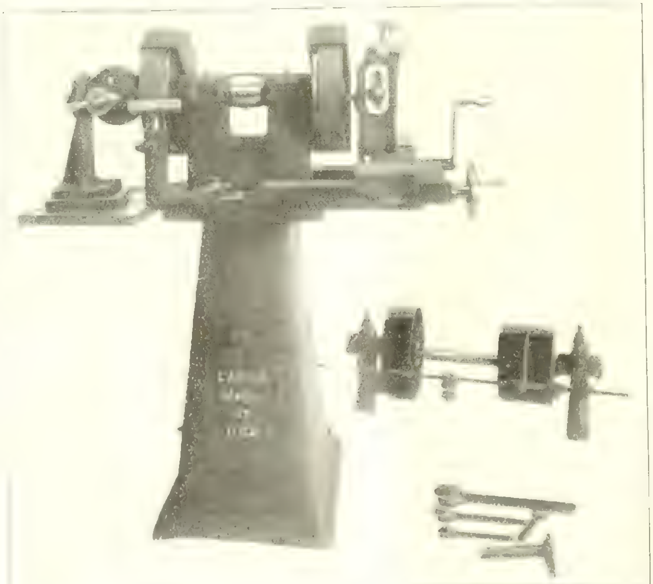
The graduating die is held in holder [illegible] revolves with the die winding a spring tension which as soon as contact with work is broken returns work holder to its proper position to mark the next piece. The shaft runs in bronze bearings with collar adjustment. The work is held in [illegible] cut gears; depth of impression is provided by foot pressure through a lever and cam which is adjustable so that it is possible to regulate the depth of impression to an hundredth part of an inch. This means that even and accurate impressions can be secured.

The machine is suitable to graduate not only fuse caps but any bevel surface such [illegible] machines or any machine that uses these [illegible] to put lettering on in place of graduations on bevel surfaces and will give excellent results. The saving of time and labor to the manufacturer by using this machine for graduating or lettering any article on bevel surfaces is surprising, as with one turn of the hand lever a com- [illegible]

The New Landis Chaser Grinder.

The chaser grinder illustrated herewith has recently been perfected by the Landis Machine Company, Waynesboro, Pa., to meet the demands and requirements of the many users of thread cutting dies and more especially the well-known Landis die, manufactured by that company. The machine is of a duplex nature, in that it is fitted with an attachment for handling all sizes of Landis chasers and a device to sharpen the disc cutters of roller pipe cutting machines. It may also be used to grind lathe, planer, shaper tools, etc.

The chaser grinding attachment has adjustment in both horizontal and vertical planes with suitable graduations for controlling the lead and rake angles, on Lan- [illegible] tudinal feeds are in horizontal planes, a feature which insures very accurate grinding. A close inspection will reveal the ex- [illegible] over- hang to protect the guides from emery dust. The disc cutter grinding attachment is also adjustable vertically and horizontally and is operated by hand. An [illegible] facilitate the handling of miscellaneous tools. The rigid construction, guarded wheels and the ease with which the machine may be operated are features which should not be overlooked, and which, together with the universal adaptability of the machine should make it a most desirable equipment for the tool room.



[illegible] GRINDER

Wootz Steel.

A correspondent wishes to know something concerning Wootz steel and if it is used to any extent by railroad companies? In answer we would say that Wootz steel is made exclusively in India and that its production dates as far back as the making of iron. It is made from a fine quality of native ore melted in crucibles containing a quantity of dried wood or leaves. It is made in very small quantities and is therefore very expensive, the weight of a bloom ranging from one to three pounds.

Wootz steel has been successfully imitated in Europe. Small pieces of Swedish iron are put into a crucible and covered with charcoal, the air being carefully excluded. This mass is exposed to heat until it turns dark gray carburet of iron. This is very brittle and is easily pulverized. When ground up fine, it is mixed with aluminum and subjected to an intense heat when it becomes white. A certain percentage is then mixed with small pieces of good steel and the whole melted in a crucible. The product is a metal which passes for Wootz steel and is said to be just as good for some purposes. We never heard of a railroad using Wootz [illegible] ...itation

The WHY Of

DIXON'S FLAKE GRAPHITE

You use lubricants to save wear. The worth of any lubricant is in its value as a wear-reducer—not in its cost.

Oil and grease — **good** oil and grease — are good. But—they don't solve the friction problem. Why?

Because friction is the rubbing of metal on metal in bearings. Oil or grease can't prevent that, because they haven't the "body." They squeeze out, or run out, or dry out, or work out, of a bearing.

The only thing that fills the bill is a solid lubricant, like **Dixon's Flake Graphite.** Mixed with oil or grease to distribute it, Dixon's Flake Graphite becomes a part of the bearing surfaces—forms a firm veneer of solid lubricant over the metal.

Then you have graphite gliding on graphite, instead of metal grinding on metal. You have an anti-friction bearing surface that grows harder, smoother, with increasing service and pressure.

The secret of Dixon's lies in its flake quality—the fine flakes are the only form of graphite that identifies itself with the bearing metal — that builds up a solid lubricating veneer.

Therefore—don't fancy any graphite will do. You want a true natural flake lubricating graphite such as is produced by Dixon alone.

Send for "Graphite Products For the Railroad," No. 69.

Made in JERSEY CITY, N. J., by the

JOSEPH DIXON CRUCIBLE CO.

Established 1827

RAILROAD NOTES.

The Southern Utah has five standard locomotives for sale.

Greece is said to have made inquiries in this country for locomotives.

The Illinois Central is in the market for 1,000 50-ton refrigerator cars.

The Pere Marquette is said to be in the market for 5,500 tons of rails.

The Illinois Central is in the market for 25 switching and 25 Mikado type locomotives.

The Union Tank Line has ordered 500 tank cars from the Standard Steel Car Company.

The Westmoreland Coal Company is reported in the market for a hundred 50-ton gondola cars.

The Peoria & Pekin Union is in the market for twenty-five second-hand hopper coal cars.

The Lehigh Valley has placed an order for about 5,000 tons of rails with the Bethlehem Steel Co.

The Illinois Southern has placed an order for 300 box cars with the Haskell & Barker Car Company.

The Philadelphia & Reading has placed an order for 200 underframes with the American Car & Foundry Co.

The Chicago & Eastern Illinois bridge shop and pattern rooms at Danville, Ill., were recently destroyed by fire.

The Eddystone plant of the Baldwin Locomotive Works has been put on full time temporarily, it is reported.

The Westmoreland Coal Company has ordered 100 gondola and 100 hopper cars from the Cambria Steel Company.

The American Locomotive Company is reported to have received an order for 20 locomotives for export to Greece.

Port Huron, Mich., has raised a bonus of $100,000 to insure the rebuilding in that city of the shops of the Grand Trunk.

The Philadelphia & Reading has placed an order for 400 hopper sides and underframes with the American Car & Foundry Co.

The Illinois Central placed an order for twenty-five switching locomotives with the American Locomotive Company, and is in the market for twenty-five additional locomotives.

The Maine Central has ordered seven Mikado locomotives equipped with superheaters, from the American Locomotive Company.

The Carolina, Atlantic & Western has ordered 3 ten-wheel and 1 six-wheel switching locomotives from the Baldwin Locomotive Works.

About 1,600 former employes of the Southern Pacific California shops who were laid off several weeks ago have been ordered to return to work.

The Federal Signal Company has been given a contract for a mechanical interlocking at Tivoli, N. Y., on the New York Central & Hudson River.

The Jane Oil & Gas Company, St. Louis, Mo., has ordered 100 tank cars from the Pennsylvania Tank Car Company and 50 from the American Car & Foundry Company.

The Great Northern has ordered three mail and express cars, two baggage cars, three smoking cars, three parlor cars and ten coaches. The order was placed with the Barney & Smith Car Co.

The Chicago Great Western has just awarded contracts for the erection of three water tanks to the Chicago Bridge & Iron Company. They will be located at Randolph, Minn., Oelwein, Ia., and Parnell, Mo.

The R. L. Murphy Construction Co., East St. Louis, have been awarded the contract for a new roundhouse and other improvements for the Southern at east side yards. The contract amounts to about $167,000.

The Intercolonial has placed orders as follows: Six coaches from the Canada Car Co., 200 flat cars from the Nova Scotia Car Works, 250 coal cars from the Eastern Car Co. and eight sleeping cars from the National Steel Car Co.

The Atchison, Topeka & Santa Fe has ordered 54,000 tons of 90-lb. rail from the Colorado Fuel & Iron Company and 12,000 tons from the Illinois Steel Co. This road is also reported to have placed an order for 6,500 tons of tie-plates with the Rail Joint Company.

The Northern Pacific has placed an order for the following equipment with the Pullman Co.: Eighteen mail and express cars, 4 dynamo baggage and mail cars, ten dynamo baggage cars, seven baggage cars, six diners and forty-seven coaches. These are all of steel construction and are for March delivery. The order totals about $1,000,000, it is said

Making and Repairing American Anvils

It is gratifying to learn that the enterprising manufacturing firm Hay-Budden Company, 254 North Henry street, Brooklyn, whose American-made anvils have won an enviable place among the railway appliances, has continued to maintain the position as the leading anvil makers in America. When the destructive tariff reduction, or more properly speaking, almost entire tariff abolition, threatened to extinguish the industry in America, the closing of the North Sea to commerce has had a deterring effect on the introduction of the cheap labor article from northern Europe. Not only so, but the general depression in the railway supply department has created a demand, among other economical measures, to repair anvils that may be slightly damaged. In this regard the Brooklyn firm has shown a readiness to rise to the occasion with the result that damaged anvils may be completelly restored and in every way made the same as new anvils for about one third of the price of a new anvil.

With an increase in the railroad freight rates, and a gradual return to better business conditions, doubtless the demand for the best American anvils will soon resume normal conditions, and probably by the time that the warring nations in Europe agree to beat their swords into pruning hooks, a kindlier spirit towards American manufacturers may take possession of the minds of our bewildered legislators, if they have such a thing as a mind about them, but in regard to this latter hope we are not praying for miracles. In any event a firm that has established an industry and carried it on in the face of legislative difficulties, by sheer force of business enterprise and inventive intelligence, cannot be extinguished.

The Most Wonderful Railroad in the World.

When all the great railroad trunks of the world have been built, a decade or two hence, four of them will appear upon the map in heavy black, indicating that they surpass all others in importance. These will be: the Pan American, from the Arctic wastes of Canada to the Straits of Magellan; the Trans-Siberian, from the Atlantic to the Pacific across northern Europe and Asia; the Trans-Persian, or some other line, from the southeast of Europe to India; and the Cape-to-Cairo. The Pan-American and the Indo-European railways may surpass the Cape to-Cairo as commercial arteries, and the Trans-Siberian will doubtless figure more potently as a strategic line; but for the sheer interest of the country traversed—for the picturesque variety [illegible] running like double cinematograph films [illegible] trunk can never know a rival.

Six thousand miles, across sixty-five degrees of latitude; a score of climates and the lands of a hundred different peoples or tribes; the second longest of the world's rivers and two of its largest lakes; the greatest dam ever built, conserving water for the world's richest lands; the most imposing and ancient of all temples; the greatest waterfall, and the most important gold and diamond mines; and finally, one of the last great expanses of real wilderness, the only place in the world where the wild beasts of the jungle may be seen in their primitive state from a train, all these seen, traversed, or experienced in twelve days! Surely, there can never be another such railway as this.—*Lewis R. Freeman, in The World's Work for January.*

A Railroad Story.

Railroad men will be interested in Sir J. Henry Yoxall's account (in his "The Wander Years) (Dutton) of the beginnings of railroad building in Belgium (then Flanders). "In 1837," he writes, "when Dickens first went gallivanting off on his wander-years, there was not an inch of railroad in all Flanders to be seen. Not till the days when he went to Italy through France—and then he traveled 'post,' as he made the Dorrits do, you remember—did the iron road begin to run anywhere in Belgium. The diligences still held the highway, 'Fugio ut Fulgor,' proudly bragged in large gilt letters on their dash-boards. There is a yarn of what certain Belgian engineers did when they came back from England with whole sheaves of sketches, plans, specifications and particulars about 'the new English traveling road,' and were set to build one like it in the low country. They made their first railway across the flats, and when it was finished, on almost the very day before it was to be opened with royal pomp and circumstance, the chief engineer, looking at the [illegible] his own achievement, struck his forehead with sudden tragical gesture and [illegible] cutting they could find."

[illegible] ccident [illegible] Well [illegible] thing you keep your eye on, and another you keep your foot on, and another you [illegible] got my anatomy in the wrong places."

"And you say that Browney was cured of a bad attack of insomnia by suggestion?" "Yes, purely by suggestion! His wife suggested that since he could not sleep he might as well sit up and amuse the baby. It worked like a charm."

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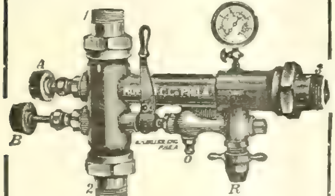

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Books, Bulletins, Catalogues, Etc.

Tool Foremen's Association Report.

The official proceedings of the American Railway Tool Foremen's Association held in Chicago, Ill., in July, 1914, have just been issued in a volume of [illegible] pages, printed on toned paper and profusely illustrated. The growing importance of the association is clearly shown in the interesting volume and the variety of subjects discussed and the wealth of information conveyed is the best proof of the usefulness of the association. Of special interest is the work that is being done towards the standardization of reamers and other kinds of smaller tools. Some of the committees are continued from year to year, and in this way the accumulation of data assumes a value not common to the work of committees whose period of service may be more limited. A list of members is attached to the volume, and those desiring copies should apply to the secretary-treasurer, Mr. Owen D. Kinsey, 7223 Ridgeland avenue, Chicago, Ill.

Lightning Arresters for Series Lighting Circuits.

Bulletin No. 45602 has just been issued by the General Electric Company and deals with the subject of the protection of series lighting circuits by lightning arresters. The arresters described in the bulletin are of two types: the horn type and the aluminum type. The former is designed for the protection of series transformers and rectifiers against lightning discharge and similar trouble, and the latter particularly for the protection of cable circuits running from series arc rectifiers. Illustrations and dimension diagrams on the various arresters are included in the bulletin.

Reactions.

The last quarterly issue of *Reactions* for 1914, a publication devoted to the science of aluminothermics, contains much interesting matter particularly in regard to welding vertical pipe with thermit. There are also over a dozen illustrations and descriptive matter in regard to recent welds on some of the leading railroads, all of which are apparently of more than usual difficulty of accomplishment. As an example four welds are shown on a truck frame that had literally fallen to [illegible] as good as new but better. Similarly shattered was a Mallet frame on the Carolina, Clinchfield & Ohio, where three welds were made expeditiously and successfully. Indeed there seems to be a part of the modern locomotive that [illegible] all reached by the advanced methods of thermit welding as applied by the Goldschmidt Thermit Co. Copies of their interesting publication may be had on application at the main office, 90 West street, New York.

Patent Reports.

Of all kinds of literature perhaps patent reports is the least edifying. A needle may be found in a haystack, but anything of value is hard to find in a government report. Mr. P. Cook's book has come to the rescue of railway men, and after much labor he has produced a compilation of the patents relating to nearly all inventions for railway rolling stock appliances and equipment. If an inventor is working on an invention relating to railways, by simply looking at the different classifications in this book he can immediately determine how many patents have been granted on such class of devices. We cannot recall seeing a work of this kind before, and the information contained if desired would cost considerable from any other system or source. Copies of the book may be had on application to the author, Victor Building, Washington, D. C.

The Parcels Post.

At the November meeting of the New York Railroad Club a paper was read by Mr. V. J. Bradley on "The Parcels Post and Its Effect on Railway Revenues."

The tendency of the paper was to prove that the post office officials of the United States Government are prepared to embark their employees in the business of conducting a parcels express with no limit to the business. One salient paragraph [illegible]

"The parcel post, by the creation of a large amount of new business as well as by taking some business from the express companies, has greatly increased the tonnage of the mail transported without any adequate provision for the payment thereof to the railroads that are performing the service. It is of great importance that such remedial action be taken promptly, not only because justice to the railroads requires it, but also that the Government may obtain information as to the full cost of performing the parcel post business. The knowledge of the full [illegible] cost will save Congress from approving parcel post rates which would result in a heavy increase in taxation, unless Congress in representing the people should deliberately decide to decree general taxation to pay for the performance [illegible]

ordinary citizen, but which might be largely monopolized by the mail order houses and other great business establishments."

Another paragraph reads:

"While it is quite possible, as Mr. Bradley states, that the reduction in express revenue 'is more due to the new rates prescribed by the Interstate Commerce Commission than to the competition of the parcel post,' there is no doubt that the parcel post is a potent factor in effecting this reduction, and if the Postmaster General sees fit to further extend the parcel post service and to increase its effectiveness, as he has clearly indicated that he intends to do, undoubtedly at least some of the express companies will be forced out of business. This will result substantially in government ownership, not by orderly acquisition, through the purchase of the express companies' property at actual value, or even by condemnation proceedings, but by enforcing destructive competition."

Small Turbo-Generator Sets.

The General Electric Company has just issued an attractive bulletin on the above subject. It illustrates and describes in considerable detail the horizontal turbine sets of small capacities manufac- [illegible] are built in capacities ranging from 7 kw. to 300 kw. direct current, and 100, 200 and 300 kw. alternating current, and are used largely for supplying light and power in mills, machine shops, laundries, bakeries, breweries, apartment houses, etc., as well as for train lighting. The turbines can be furnished for either condensing or non-condensing operation and, in general, for any steam pressure of over 80 pounds. The number of the bulletin is 42010.

Railway Postal Cards and Colored Plates.

[illegible] Corner, Paternoster Row, London, as usual at this season of the year has issued an extensive edition of specially bound post card albums of various sizes [illegible] in [illegible] every kind of British locomotive, as well as a [illegible] of American and other locomotives. The prices are 25 cents per dozen. The specially [illegible]

Report on Locomotive Boilers.

[illegible] has just issued the third annual report [illegible] boilers, and it is very [illegible] to observe the large improvement indicated [illegible]

there were 91 fatalities recorded, in 1913 the number was 36, and in 1914 the number is reduced to 23. The tables are so conclusive that nothing further that might be said could add or take away from their weight.

Steam Engine-Driven Generator Sets.

[illegible] the General Electric Company, is described that company's line of small direct connected generating sets of sizes ranging from 2½ kw. to 75 kw. While ordinarily designed to meet the severe conditions of marine work demanding light, compact and durable sets of close regulation and quiet operation, they are also well adapted and used extensively for [illegible] plants, and as exciters for alternating current generators in central station work. Both the engine and generator are described in the bulletin in considerable detail.

Traveling Engineers' Proceedings.

A handsome volume of 454 pages, bound in leather and printed on excellent paper, compiled and edited by Mr. W. O. Thompson, East Buffalo, N. Y., secretary of the Traveling Engineers' Association, is just issued, containing the Proceedings of the Twenty-second Annual Convention of the Association held at Chicago, Ill., in September of last year. The volume is another valuable addition to the annual reports published by the Association, and shows how intelligently and tenaciously the members have adhered to their original purpose to improve the locomotive engine service of American railroads. The subjects treated embrace smoke prevention, maximum efficiency at lowest cost, advantages of stokers, training of firemen, utilizing cheaper grades of coal, care of locomotive brake equipment, locating defects, speed recorders, and chemistry of combustion. All of these subjects are treated with the highest degree of intelligence. The papers and discussions are the best reflex of practical minds actively and constantly engaged on the subjects. Copies of the report may be had from the Angus Sinclair Company, [illegible] the secretary of the Association. Price, [illegible]

Ring out the old, ring in the new,
Ring happy bells across the snow;
The year is going, let him go,
Ring out the false, ring in the true.

Ring in the valiant man and free—
The larger heart, the kindlier hand,
Ring out the darkness of the land,
Ring in the Christ that is to be!

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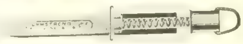

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Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVIII. | 114 Liberty Street, New York, February, 1915. | No. 2

Electric Towing System for the Panama Locks

The electric towing system for the Panama Canal locks was designed and patented by Mr. Edward Schildhauer, electrical and mechanical engineer of the Isthmian Canal Commission, and the forty towing locomotives and all the electrical apparatus for operating the locks were built by the General Electric Company.

In passing through the canal from the Atlantic to the Pacific, a vessel will enter the approach channel in Limon Bay, which extends to Gatun, a distance of about seven miles. At Gatun it will enter a series of three locks in flight and be raised 85 feet to the level of Gatun Lake. It may then steam at full speed through the channel in this lake, for a distance of 24 miles, to Bas Obispo, where it will enter the Culebra Cut. It will pass through this cut, which has a length of nine miles, and reach Pedro Miguel, where it will enter a lock and be lowered 30 feet. Then it will pass through Miraflores Lake for a distance of 1½ miles until it reaches Miraflores, where it will be lowered 55 feet through two locks, to

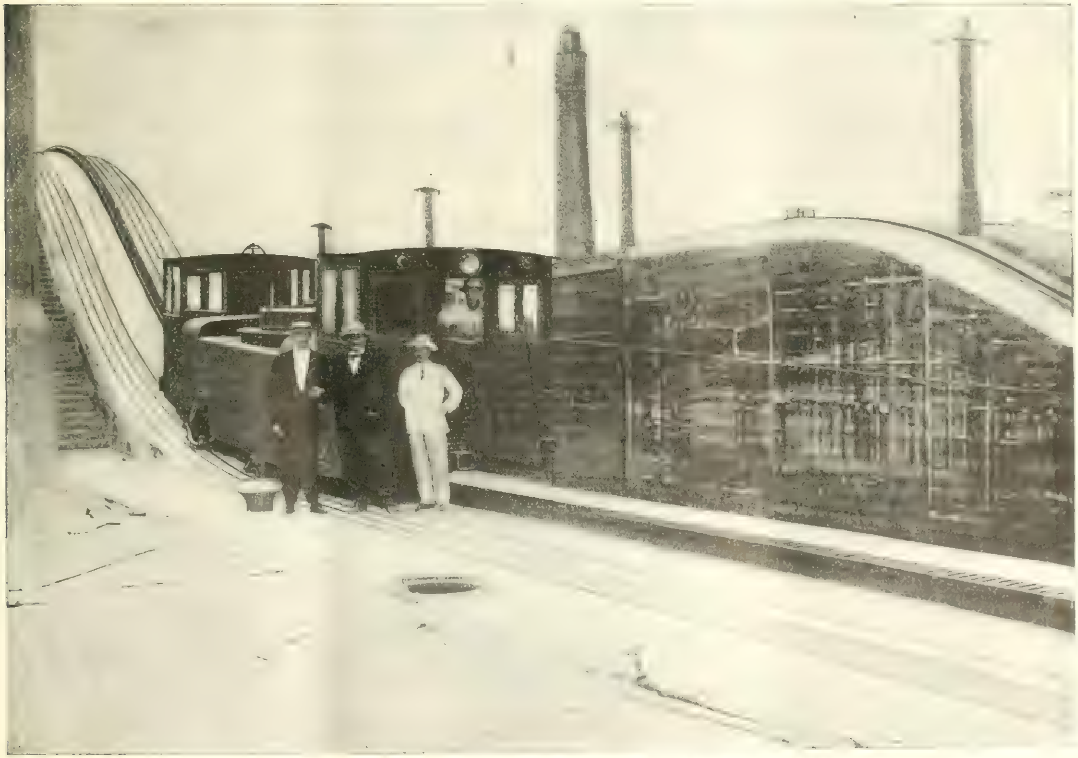


FIG. 1. TOWING LOCOMOTIVE ABOUT TO ASCEND THE INCLINE [illegible]

Standing in the foreground, left to right, are: Edward Schildhauer, [illegible] Lt. Col. William L. Sibert, Isthmian Canal Commissioner and Atlantic Div[illegible] Engineer; C. W. La[illegible] Industrial Locomotive Designing Engin[illegible] General Electric Company.

[illegible] into the Pacific through an 8½-mile channel.

The main features of all the lock sites are identical, and in Fig. 1 it is noted that there are two ship channels, one for traffic in each direction. The channels are separated by a center wall, the total

[illegible]

U. S. S. "Severn" L[illegible]

[illegible] 6,530 [illegible] There are two systems of tracks, one for towing and the other for the return of the locomotive when returning idle. This, however, refers only to the outer walls. For the center wall there is only one return track in common for both the towing tracks. The towing tracks are naturally placed next to the channel side, and the system of towing utilizes normally not less than four locomotives running along the lock walls. Two of them are opposite each other in advance of the vessel, and two run opposite each other following the vessel. The number of locomotives is, however, increased when the tonnage of the ship demands it.

Cables extend from the forward locomotives and connect with the port and starboard sides respectively of the vessel near the bow, and other cables connect the rear locomotives with the port and starboard quarters of the vessel. The lengths of the various cables are adjusted by a special winding drum on the locomotive to place the vessel substantially in mid channel. When the leading locomotives are started they will tow the vessel, while the trailing locomotives will follow and keep all the cables taut. By changing the lengths of the rear cables the vessel can be guided; and to stop the vessel, [illegible] stopped, thus bringing the rear locomotives in action to retard the ship. Therefore the vessel is always under complete [illegible]

[illegible] Figs. 2 and 3 give a general idea of the method of handling vessels. They also show general views of the lock walls, towing tracks and the inclines, the steepness of the latter being especially noticeable.

The towing tracks have a specially designed [illegible] the entire length of the track and located centrally with respect to the running rails. It is through this rack rail that the locomotive exerts the traction necessary for propelling [illegible] inclines.

[illegible]

[illegible] ON FIRST [illegible] RUN

[illegible]

the locomotives safely from one level to the next. The steepest slope is 44 per cent., hence the need will be seen for rack rail even on the return track, it being noted that any traction locomotive with the usual wheel drive, even with the brakes set, would begin to slide on a 16 per cent. grade and therefore could not be controlled. With a rack rail, however, traction is limited only by the capacity of the driving motors and not by the adhesion of the wheel treads on the rails.

Three-phase, 25-cycle, 220-volt alternating current is used for operating the locomotives, and the current is supplied to the locomotives through an underground contact system. Two T-rails form two legs of the three-phase circuit, and the third leg is formed by the main track rails. A specially designed contact plow slides between the two "T" conductors and transmits the power from the rails to the locomotive. This contact plow also passes through the slot opening in the conduit cover and is flexibly connected to the locomotive in such a manner as to follow all irregularities in the tracks and crossovers, and therefore insures a continuous supply of power.

The working parts of the locomotive are supported by two longitudinal upright side frames of cast steel, connected by transverse beams. These frames are in effect deep rigid trusses, having upper and lower members connected by posts, and diagonal braces. The elevation and plan view are shown by Figs. 4 and 5.

Each axle is driven by its own motor, a front view of which is shown by Fig. 6, independent of the other.

The motor is of the three-phase, slip-ring type, enclosed, and is geared by a pinion and spur gear to the countershaft, which carries a pinion, meshing with a spur gear, keyed to the jack shaft. On the outer side of the spur gear are formed clutch teeth which co-operate with similar [illegible] which is sleeved upon the jack shaft and can be slid lengthwise thereon to engage and disengage the clutch teeth. A pinion [illegible] keyed to the axle and is wide enough [illegible] mesh always with the gear, so that when the clutch teeth are engaged, the [illegible] will propel the locomotive by the [illegible] between the wheels and the rails [illegible] track, and this only when running

without load and between the inclines.

When the locomotive, however, reaches one of the inclines between the locks, the grade of which may be as much as 44 per cent., or when it is towing a ship, the cog rail system is utilized to enable the locomotive to climb the grade and exert traction necessary for pulling large ships. The cog or rack rail is laid between the track rails, and the locomotive is provided with a cog wheel or rack pinion, secured to or integral with a sleeve which rotates solenoid is pivoted to the long arm of a lever which is fulcrumed on one of the brake levers. When the core of the solenoid drops, it actuates the lever and the rod in such a manner as to draw the two brake levers towards each other and thereby apply the brake shoes to the drum. The winding of the solenoid is in circuit with the controller of the motors, so that when the current is turned on to energize the motor windings the solenoid will lift its core and thereby release the when coiling the cable that has been cast off, and it remains permanently in gear. Another motor with worm gear drive is used for taking in the cable when it is under load, and the drum operates as a windlass or capstan. Due to the greater gear reduction, it operates the drum at a much slower speed, and consequently, with motors of approximately equal size, a greater force may be exerted on the tow line than would be possible with the lower speed reduction which is used with

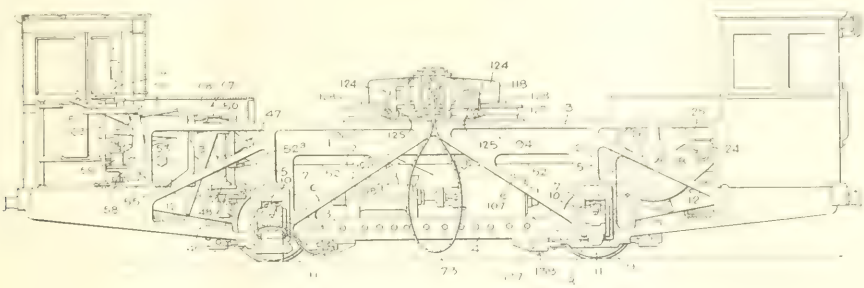


FIG. 4. SIDE ELEVATION OF TOWING LOCOMOTIVE WITH COVERS REMOVED.

freely on the axle. A gear wheel, secured to or integral with this sleeve, meshes with a gear, turning loosely on the jack shaft. Clutch teeth on this gear can be engaged by the teeth on a clutch which is splined to a jack shaft.

It will be observed that each motor, with all its gearing and clutches, is mounted independently of the frame of the locomotive, to which it is connected brakes. The first point of the controller raises the brakes without applying power to the motors, thereby providing a coasting point. But should the motor current be shut off, either intentionally or accidentally, the core will instantly drop by gravity and its weight will exert a powerful leverage upon the brake levers to stop the motor and the locomotive. This action occurs simultaneously on both mo- the high-speed coiling motor. The worm gear drive is disconnected from the drum when not in use.

One of the most important parts of the locomotive is the "slip-friction" device consisting of two special alloy rings, mounted on the spider. Between these rings a steel disc is fastened to the rope drum; and the amount of tension on the tow line is adjusted by the pressure be-

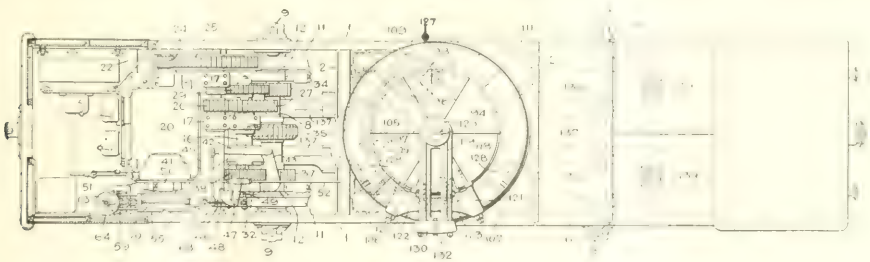


FIG. 5. PLAN VIEW OF TOWING LOCOMOTIVE [illegible]

only by springs, which give an elastic support.

In connection with each motor a powerful brake is installed, and, as during operation the motors are at all times geared either to the axles or to the cog wheels, the truck wheels are not provided with any brake rigging. On the motor shaft is keyed a brake disc or drum, and to opposite sides thereof are applied the brake shoes, carried by the brake levers, which are pivoted on a stationary bar projecting from a frame which supports a solenoid. The movable core of this tors, and brake [illegible] to stop the locomotive within two revolutions of the wheel.

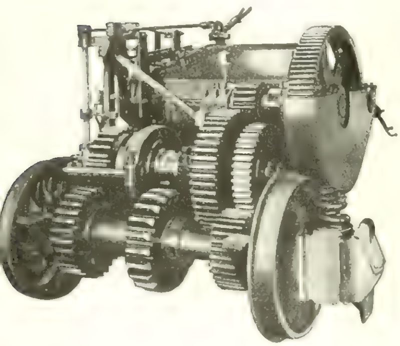
Passing now to the features which render the locomotive peculiarly adapted for towing purposes, the drum on which the cable is wound is located midway between the ends of the locomotive and above the upper member of the side frames, so that the cable can be led off on either side of the machine and through a wide range of angles to the line of travel.

A [illegible] for driving the drum at a high speed tween these three discs, and is obtained by tightening the spiral springs on the clamping ring. In order, therefore, to make the slipping tension of the towline proportional to the pressure between the friction discs, a rubbing surface having an absolutely constant coefficient of friction is essential. The low friction metal, having a friction coefficient of 0.1, is practically constant under all pressures and condition of the surfaces, and therefore was selected for the work. This metal also showed but very little difference in coefficient between starting

and [illegible] special tests were furthermore amply verified by the final test of the friction discs of each machine under full rated tow-line pull of 25,000 pounds by means of the dynamometer testing outfit. All forty machines were given this slip test twenty-five times from each cab, and all passed the government requirement not to exceed a [illegible] below the normal of 25,000 pounds.

In connection with the slip test, further data on the slow winding motor was obtained. It was found to have ample power to take care of any sudden pull on the tow-line up to 40,000 pounds, which is well above the normal requirement of 25,000 pounds. The speed of winding is at the average rate of 12 feet per minute.

The locomotives have a net weight of 86,300 pounds and a gross shipping weight of 92,500 pounds. They were mounted on specially designed skids and [illegible] New York where they



[illegible] PANAMA [illegible] LOCOMOTIVE [illegible]

were loaded on board the ships as deck cargoes by means of a Merrit-Chapman 125-ton floating derrick. Among the ves- [illegible] this case carried six locomotives to the Isthmus.

During the first three months of commercial operation of the canal, from August 15 to November 15, the cargo transported through the canal and towed through the locks by the locomotives amounted to 1,079,521 tons. During the fiscal year ending June 30, 1914, the Pan- [illegible] of through freight between the two seaboards, and in the preceding fiscal year 594,040 tons. From this it is seen that [illegible] cargo is passing over the Isthmus now as passed over this route when goods were [illegible]

Quebec Bridge.

At the annual meeting of the Dominion Bridge Company, held last month, it was stated that in December about 42 per cent. of the steel for the superstructure of the new Quebec bridge had been fabricated, and about 18 per cent. erected. It is anticipated that the work will be finished in good season, and within the original estimates of cost.

Railroad Crossings in Kansas.

The New York *Times* is responsible for the statement that in an endeavor to straighten out conflicting interests at level crossings in Kansas railroads, a bill has been introduced in the State legislature in which the statement is said to appear that "when two trains approach a railroad crossing, both shall stop and neither shall go ahead until the other has passed by."

National Transcontinental Railway.

The Minister of the Canadian railways made a tour of inspection of the Transcontinental railway last month from Quebec to Lake Superior Junction. The section of the line from Moncton to Levis is being operated under the Canadian government railways' management, and the section between Lake Superior Junction and Winnipeg is being operated by the Grand Trunk Pacific Railway, under an arrangement with the department. It is expected that arrangements will be completed for the operation of through traffic early in the spring.

Oil Fuel in Honduras.

The Vacarro Brothers & Co. Railroad, operating from Ceiba into the banana lands, has equipped locomotives for burning oil instead of coal, the present fuel, to ascertain the desirability and economy of oil as a fuel. If the experiment proves a success it is possible that not only he locomotives but the shops and various kindred enterprises controlled by the company will be equipped for the use of oil as a fuel.

Government Ownership of Railroads.

Hon. Jonathan Bourne, Jr., speaking before the National Civic Federation, in New York last month in the course of an able speech presenting objections to government ownership of railroads, said: "Can any person familiar with the politics of this country doubt the correctness of the assertion that, under government ownership of these public service corporations, with the resultant addition of over two and a half million employees to the government pay roll, those employees and their friends would inevitably control the government under our political machinery. The tendency would be [illegible] mental employment, resulting in ceaseless efforts on the part of outside labor to secure government employment because less onerous and more remunerative, with cumulative dissatisfaction and irritation in all private enterprise.

Safety in the West.

The safety and efficiency bureau of the San Pedro, Los Angeles & Salt Lake reports a reduction of about 34 per cent. in the number of injuries to employees for last year, as compared with the preceding year. The number of fatal accidents among employees was three, the lowest record in the history of the road. Every man on the road seems to be imbued with the spirit of Safety First.

New Equipment on the Rock Island.

The annual report of the Chicago, Rock Island and Pacific has just been issued, and it appears that in the items of new equipment there were 57 locomotives, 70 all-steel passenger train cars, 2,050 freight train cars and 2 wrecking cranes received during the year and added to the equipment. The first two railroad leases of the company also made additions to the rolling stock, viz., 18 locomotives, 9 passenger train cars and 351 freight train cars, all of which, excepting five pieces, came with the St. Paul & Kansas City Short Line. Thirty per cent. of the cars in passenger service are of all-steel construction. Of the total mileage of passenger train cars, exclusive of Pullmans, 46 per cent. was by cars of all-steel build.

New Railway Signal.

A mere piece of red glass has made it possible to use red light on railroad crossing gates, and add greatly to the safety of motorists and other drivers at grade crossings. This has never been possible before for fear of confusing engineers on passing trains, but a simple device worked out in the signal department of the Lehigh Valley Railroad has made feasible the adopting of red lights at every grade crossing in the country. It has been tried out at the busy Wyandotte Street crossing in Bethlehem and has proved a success. The ordinary crossing gate has a white light hung to the bar, which at night indicates by its position alone whether the track is clear. But by this device a piece of red glass [illegible] roundel, as in a frame, is fastened to the bar so that the white light swings behind it and shows red when [illegible] is down. When the [illegible] is up, as the roundel is stationary and the light swings, the light comes out from behind the red glass and shows white again. At no time is the red light visible from the track, and traffic on the railroad is not interfered with, but the safety of motorists and the drivers of other vehicles is [illegible]

Progress in Car Construction.

At the forty-eighth annual convention of the Master Car Builders' Association, Providence, Mr. K. Barnum delivered a very interesting opening address, in which among other good things he said:

Many freight cars originally of wood construction are being practically rebuilt and strengthened with steel underframes, friction draft gear, steel ends, new roofs, new siding, etc., so that they are stronger and better than when first built, and their ultimate life will be prolonged probably fifteen or twenty years. These improvements usually cost from $250 to $400 per car, a part of which is properly chargeable to capital account, and it seems only fair that some allowance should be made for them in figuring the depreciation when such cars are destroyed, and that those companies which are spending such large amounts to strengthen their cars should not be penalized for so doing, as at present. This subject is of sufficient importance to justify appointing a special committee to study and report upon it at the next convention.

The building of new wooden passenger cars was practically stopped a year or more ago, and most roads are applying steel underframes and ends to the older cars as fast as money can be obtained for the work, with the result that there are now 3,566 less wooden passenger cars in service than there were two years ago, so with the general use of steam heat and electric lights passenger travel on steam railroads is steadily growing safer. The fact that in 1912 the number of passengers killed in train accidents was only one for each 251,000,000 passenger miles has enabled insurance companies to pay double and triple indemnities for such accidents, and, as stated before, the conditions are steadily improving.

Railway Construction in Norway.

The Norwegian Storthing passed in the year 1908 a complete plan for railway construction for the ensuing twelve years, till 1920. It was intended that a new plan for continuing the development should be ready in good time. As the original plan has been abandoned in some respects, as for instance in the building of the Rauma Railway and the Thelemark Railway, the drawing up of a new plan has now become a necessity. The preparatory work in this connection is progressing, and the railway authorities expect that they can get the new program ready to be laid before the legislature in the year 1918.

To Run Trains by Wireless.

After a six months' trial, officers of the Delaware, Lackawanna & Western announce that they will replace the wire system of telegraphy in the operation of their passenger trains between Hoboken, N. J., this city, and Binghamton, N. Y. It is said that the company is equipping a wireless station in Buffalo, and when this in operation the transportation department will be able to communicate direct from its Western terminal to its Eastern terminal, Hoboken.

Snoqualmie Tunnel Completed.

The Chicago, Milwaukee & St. Paul Railway has completed excavation of both branches of the Snoqualmie tunnel, and the concrete lining of the tunnel has been entirely finished last month, and the road is now in regular service for the passage of trains. The tunnel is 2¼ miles in length through the Cascade Mountains, about 40 miles east of Seattle, Wash., and the entire work has been constructed by the company by its own employees.

New Railway Bridge.

The single track bridge over the Susquehanna river at Harrisburg which the Cumberland Valley railroad—a part of the Pennsylvania system—is now using, will be replaced by a modern arch bridge. The present structure is a steel deck truss bridge of 25 spans, supported by stone piers. The proposed bridge will have 44 spans and will carry two tracks. The present piers will be utilized and additional piers built. The bridge will be 4,000 feet long. The foundations are already completed above the water level, and the balance of the work will be placed under contract within a short time. This is the first construction work of any magnitude to be undertaken by the Pennsylvania System for more than a year, but indications point to developments in the near future.

CAPTURED LOCOMOTIVE

Award for Eye Protectors.

At the Second International Exposition of Safety and Sanitation, held in the Grand Central Palace, New York, the grand prize has been awarded to T. A. Willson & Co., Reading, Pa., the makers of eye protectors. It was given in acknowledgment of the merits of the three Willson industrial styles—the Willson safety glass, the new Willson goggle and the Albex eye protector. This is the highest award ever given to the makers of eye protectors.

Workmen's Compensation.

By the action of New York, Kentucky, Louisiana and Maryland, exactly twenty-four states, or one-half of those in the Union, now have workmen's compensation laws. Massachusetts, after two years' experience, raised the benefits under its law from 50 per cent. to 66 2-3 per cent. of wages, and New Jersey also liberalized its rates, though to a less extent.

Captured Locomotive.

When the Russians capture a locomotive belonging to the Germans or vice versa, it is of no use to them. The Russian State railways are of the five-feet gauge, and the Prussian State railways being of the standard gauge, the captured locomotive must be mounted upon a truck and conveyed to some junk yard in the rear. Probably when the contending powers begin to exchange prisoners, they may also exchange locomotives. Meanwhile there must be engineering difficulties in transferring the locomotives to the trucks called into service for their con-

The illustration shows a captured German locomotive mounted on a Russian truck, and about to be conveyed somewhere by a Russian locomotive. The subject is no occasion for joking, but it reminds us somewhat of the man that bought a white elephant, and had to pay more to get rid of the animal than the original cost.

General Correspondence

More Notes on Small Tools and Tool Room Proposition.

[illegible] and pick out for repairs the defective ones and those that are useless for the purpose intended. Very often a large pile of wrenches must be picked over in order to find one that will fit a particular nut and perhaps many of them will not fit any size nut and are like the Dutchman's cats—don't earn their keep. It is certainly poor policy to permit or compel a skilled mechanic to spend any considerable part of his time hunting up tools when with a little systematic effort the proper tools, in good order, can be found without trouble when needed.

Many elaborate systems of distributing tools from a central tool room out over the shop, have been worked out from time to time with the purpose in view of keeping the skilled mechanic on the job as far as possible, while the tools needed are brought to him. In the main these time savers are of doubtful value. A machinist needing tools for a certain job can rarely work to advantage until he gets them, so he is quite likely to loaf in the meantime and might have saved time by going after them himself and getting just what he wanted instead of perhaps getting something en- [illegible] of scrap steel in the blacksmith's shop and at time when regular work is slack. [illegible] "Well, do the best you can," when com- [illegible] vision for all such needs in this line -it is one of the things he is paid for doing, although he too often thinks only of turning out engines and making a good showing without realizing the importance of having the proper tools to do the work to best advantage.

[illegible] processes in use that he [illegible] dreamed [illegible]

and cents and for every one published there must be dozens of others, equally good, that are never heard of outside of the locality in which they are created.

Some years ago, in a shop of the B. & O. Railway, a man got his foot crushed by a pinch bar he was using unexpectedly slipping while he was helping to pinch an engine. The general foreman con-

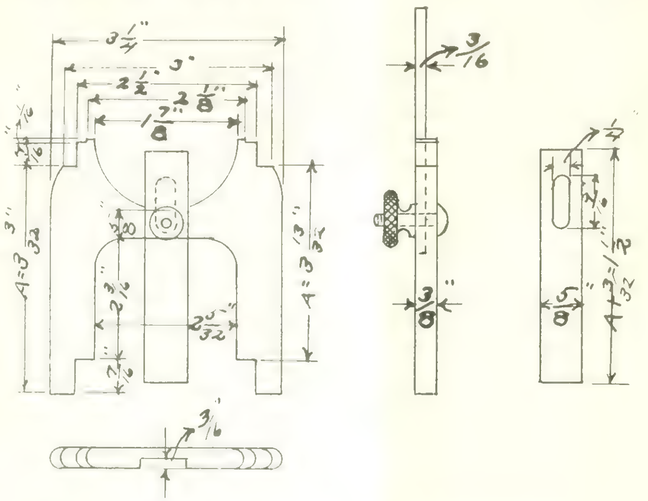
[illegible]

ducted a little investigation of his own with the result that he sent a sketch to the blacksmith shop to have a pinch bar made according to his own idea. The sketch is shown in Fig. 1, and while its value can be seen at a glance, I have never seen it used in any other shop. The improvement consists of a square channel across the face of the heel into [illegible] which forms the point of contact with the rail. The corner of the file will bite through oil and grease and never slip, it is easily replaced when worn and far superior to the tool steel triangular here commonly used.

Fig. 2 is a gauge for use in getting the proper lift of air valves in an air pump. This gauge is suitable for both top and bottom valves. For the top valves the blade is in the position shown in the plan view and for the bottom valves the blade is reversed as shown in side view.

The only exact size is the length A and the length of the blade which must be as much longer than A as the lift of the valve is to be. This gauge is very easy to use and there is absolutely no chance for error, in fact there is no work for the eye at all, as there are no figures or graduations of any kind on the gauge, which makes it especially valuable in the roundhouse or in places where the light is poor.

The gauge shown in the figure is for the 9½ ins. Westinghouse pump, and to make a gauge for the 11 ins. and cross-compound Westinghouse and the Nos. 5 and 6 New York pumps or any other pumps it is only necessary, using the same design, to increase the size to correspond to the caps, valve chambers and cages of the larger pumps. In order to obtain any lift of valve desired it is only necessary to use the proper length blade,



[illegible]

the length always being equal to the lift desired plus the length A. No detailed instructions for using the gauge is deemed necessary, as it is very simple.

The writer has one of each size made of [illegible] ins. boiler steel, but of course tool steel is better although a little harder to work. With this gauge it is possible to [illegible]

same lift, something not easily done with a scale or ordinary depth gauge.

The railroads of the country at present are going in strong for the "safety first" movement and every railroad employe should do his part in helping it along by reporting the defective tools he comes in contact with. "Slippery" pinch bars, round faced sledges, "bunhead" chisels and all such defectives are dangerous.

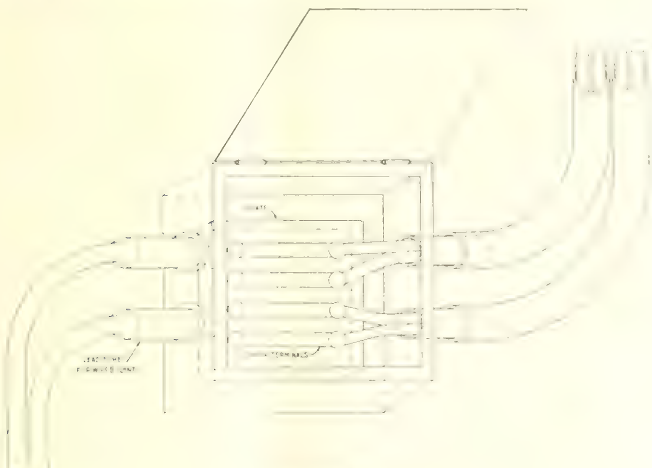
Much of the tool steel used in making hand chisels nowadays is very poor and will not stand reheating and working. Very often the cutting edge will fly off at the first blow. There ought to be, and probably is, some method of heat treatment to restore the "worn out" properties of tool steel, but it does not seem to be in general use.

Home-Made Junction Box.

By J. G. Koppel, Sault Ste. Marie, Mich.

The accompanying illustration shows a home made junction box, installed between paper insulated lead covered, and extra flexible rubber insulated and loomed cables.

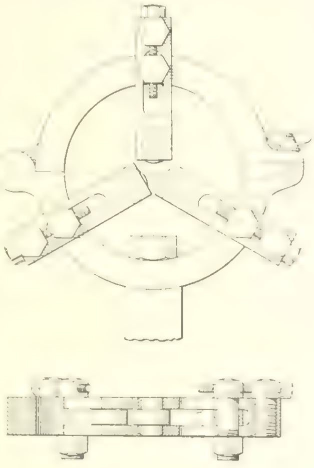
A short while ago a steam drive was discarded from a draw bridge, a duplicate cable was selected and installed underground in clay and the ends were run up to the center piers. From the center pier, below the bridge frame, a coil was made, with extra flexible rubber insulated and bound, arranged in such a way



JUNCTION BOX.

that, by swinging out, the coil will uncoil, and by swinging in the coil will recoil.

But the question arose, where to get a suitable junction box, to joint the cables so that the lead covered cables would be permanent and also the flexible cables, in case of trouble by wearing out, and disconnecting in a short time, without having to break a difficult wiped joint. Several catalogues were examined to find a suitable pot-head, but without success, because the clearance was too small between the steel and the runway to permit the installation of standard pot-heads.



STEADY REST FOR LATHES.

The matter was solved by making a steel box with hinged and rubber gasket cover. A piece of slate slab was cut from an old switch board and drilled for four copper terminals arranged with thumbscrews on each end of the terminal. Two lead sleeves were soldered on one end of the box to take the lead covered cables, and for making a wiped joint, and on the other end of the box two iron pipe nipples were used to take the loom, or legs were put on the cable ends, and secured on the terminals, and then filled full with hot ozocerite-compound. A coat of paint was given on the outside of the box to stand outside weather, which works satisfactorily.

Steady Rest for Lathes.

By R. S. Booth, Hickory, N. C.

We have in use in the railroad shops here an improved steady rest or follower for lathes designed by Mr. E. D. Sherrill, a clever machinist, which is somewhat of a departure from the standard types generally in use. The accompanying drawings will readily give an idea of its construction and use. It is supposed to be used as an additional tool part following the tool. Its width is small and it therefore is not in the way, and is easily and quickly applied. For re-turning valve stems and such work it is of excellent service, and can also be used as a roller without placing undue pressure on small shafts.

Safety in Railroading.

By [illegible] Mich.

I have often wondered when I looked at the brake hangers on some of the cars why they were put on at all. I should think it would be well to raise the factor of safety on brake beam hangers and attach safety hangers which would at least keep the beams in place or from getting down under the car and derailing it or breaking some of the air pipes should the hanger break. In the manufacture of air hose the factor of safety is high, but when the hose is old it gets weak. Air brakes have been in use now long enough so that the life of the hose could be easily determined and the hose changed before it reached the danger point.

Occasionally a wreck occurs, caused by a bursted hose, the cost of which would buy a good many thousand new ones. If a few of these had been supplied in place of the old ones it would have prevented the wreck. Triple valves going into quick action could be lessened to a great extent by cleaning the valves at shorter intervals. This, also, would remedy skid flat wheels and sticky brakes.

The power end of the rolling stock is usually taken care of fairly well, although there is room for improvement. There are many things, however, in the construction and maintenance of a locomotive where we believe the factor of safety should be raised. We are often told not to take chances, and when we are not sure to go slowly and thus attempt to make up in human efficiency what is lacking in mechanical efficiency. Would it not be better to increase the mechanical efficiency and not put the whole strain on the human end of it.

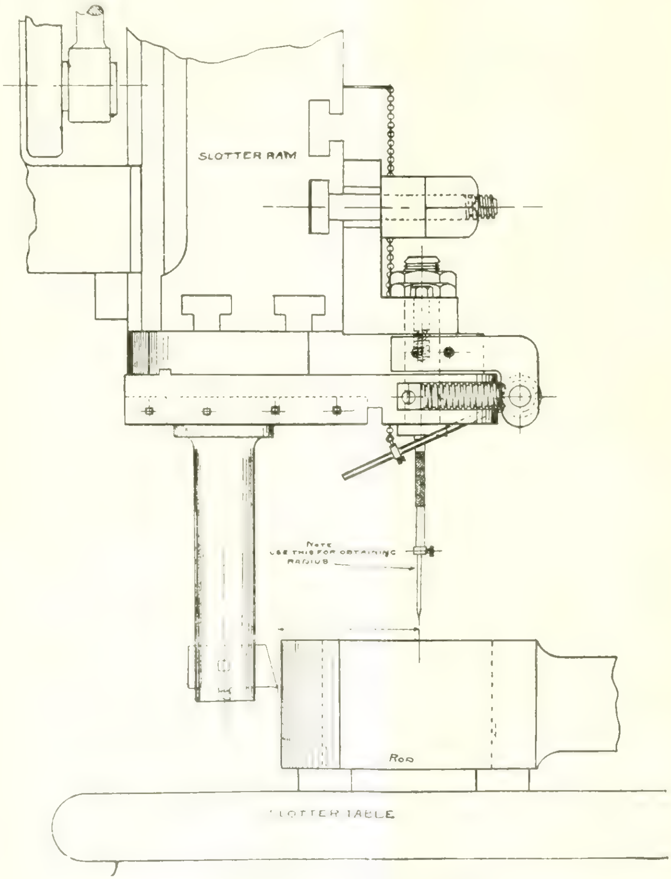
Men do not usually get into trouble

from difficulties which they are expecting to find, but from what they come upon unexpectedly. A great improvement could be made in the size and position of signal boards and signal lights, the latter in particular. Signal lights are sometimes taken care of by men who think their duty done when the light will burn through the night, whether it can be seen a mile or only a few feet. Often those who pass on the quality of oil supply an inferior grade which will crust over the wick or smoke up the lens. The lenses are generally too small and do not throw so clear and strong a light that it cannot possibly be mistaken by the engine men. The switches are not lined up to the track. Sometimes the trackmen, wishing to make the switch points fit close to the rail, move only one leg of the switch stand, thus throwing the focus out of parallel. Often a signal light cannot be seen from the approaching trains, on a curve, until close to the signal, so that speed has to be reduced to be certain. Signal boards should be placed where the background will be in contrast instead of blending with the color of the board. There is nothing that inspires an engineer with so much confidence as to see the signals clearly at an interlocking station when he is still far enough off to have plenty of time to stop, to see the switch or switch lights plainly and know for certain that he has a clear track for a certain distance ahead. The factor of safety can be raised as far as signals are concerned.

We might discuss further the human element in railroading. What are the conditions that surround the men before reporting for duty and has the period of rest been too short or too long. It might sound odd to say that a man may have too much rest, but sometimes the rest is not spaced correctly. Men on the extra or irregular runs may get their rest when they come in and then become tired in waiting for their turn out. Where if they knew just when they expected to go out they could get their rest just before their departure. Congenial surroundings at home or wherever he may lay over for rest are great factors of safety. A man going out on the road in charge of an engine or train, or assisting in any way will be a safer man if he has had proper rest just before going out. Proper food also has its part in the efficiency of the men. I do not wish to discuss the drink problem, because no railroad man can use much liquor and hold his job. Occasionally, however, we hear of a man losing his job because of drinking or being drunk. Wouldn't the factor of safety be raised if liquor were never put in the railroad man's way?

The law has stepped in and limited the hours of some railroad men because it was generally thought that they were [illegible] tired [illegible] fresh. This has been proved true and work put on to a man when he was tired out decreased the factor of safety.

Then the factor of safety must be raised in many cases. Beginning with the road bed as the foundation and building up to the top, the human element, the factor of safety may be touched up all along the line. It is said that the rope is no stronger than its weakest point. If this holds true in railroading, the weak point [illegible] and the stronger points made secure. We believe that the factor can be raised in many places to give greater confidence to the public and profit to the railroad.



RADIUS TOOL FOR CIRCULAR WORK.

Radius Tool.

By [illegible]

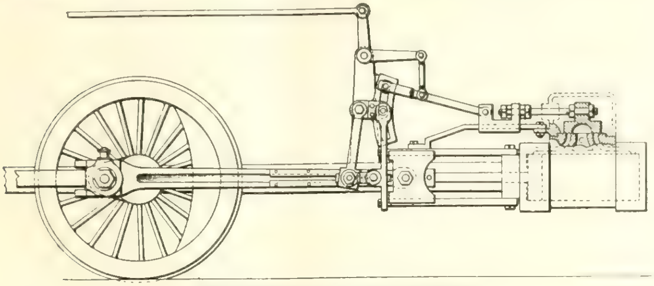
Attached drawing shows assembled a radious tool used on slotter for radius or circular work on front end of main rods or pieces which cannot be swung beyond the diameter of slotter bed. Our front end main rod brasses are round or turned-up brasses, which necessitates the front end of main rod opening being slotted round, and as it is impossible to swing the rod around to do this work is what brought out the slotter bar as shown. It will be noted that after rod or other work to be slotted is clamped to position on table, that the work or table does not revolve, but tool post turns on radius set to by ratchet, which is moved up by chain attached ram on slotter, which in turn revolves the worm shaft and tool holder bar. This bar was designed by Machinist H. F. Killean, and as details are shown, no further explanation is necessary.

It might be added that the work is done with a degree of speed in comparison with other methods, and with a degree of ac[illegible] in regard to perfection in workmanship that has not been equalled by any other appliance that has come within the observation of the writer.

A New Valve Motion.

By C. B. McCrea, Renovo, Pa.

As the subject of locomotive valve gears is always of much interest to railway men engaged in the mechanical department of railways, and as they are so ably discussed in the pages of Railway and Locomotive Engineering, I take pleasure in briefly describing a new design of valve gear which has been perfected here, and a working model of which is atracting much attention.



A NEW DESIGN OF VALVE MOTION.

The accompanying drawing is a side elevation, partly in section, and shown applied to a locomotive, the main rod of which, as usual, is connected at its rear end to the crank pin and at its front end with the crosshead, and it will be noted that the main rod is provided with a longitudinal guideway, preferably formed by the usual groove in the rod, and a pair of plates bolted to the outer face of the main rod above and below the groove, and extending inwardly over the same to form projecting flanges for retaining a slide block in the groove of the main rod. The slide block is pivoted to an upright link which is connected to a centrally arranged arm of a reverse link. The upright link is preferably forked to straddle the central arm of the reverse link. The link may be pivoted to any suitable portion of the locomotive, and the link is oscillated vertically when the upright hanger is actuated by the main rod, the distance between the upper and lower pivots, of course, always remaining constant.

The reverse link is furnished with a slidable link block which is pivoted to the rear end of a forwardly extending radius rod. The combination constitutes mechanism similar to that of the Walschaerts valve gear, and the front end of the radius rod is pivoted to the slide of the valve stem, and it is connected at an intermediate point by a lifting link with a lifting arm of a reversing shaft. The reversing shaft has an upwardly extending arm which is connected by a reach rod with the reversing lever. The device may be readily adapted to either inside or outside admission valves.

As stated when the main rod is moving the upright link moves up and down and oscillates the link communicating the motion to the valve. This movement gives an early opening and a late cut-off. When the valve is completely opened it remains stationary until the crosshead and piston has made a considerable advance. On the other hand the valve closes quickly, and it is also adapted to operate without lap or lead, and has no motion when the reversing lever is in central position. The valve gear being of the outside type, is all in full view and readily accessible.

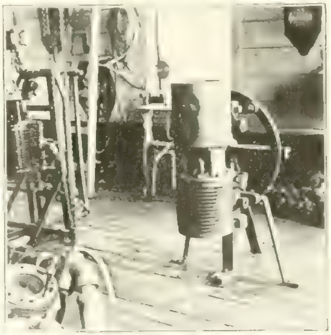
It may be added that repeated experiments in the way of securing diagrams has demonstrated the accuracy of steam admission into both ends of the cylinder.

Revolving Rack for Repair Work on 9½-Inch Air Pumps.

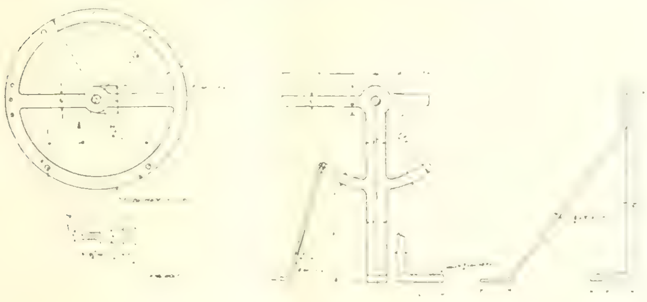
By F. W. Bentley, Jr., Missouri Valley, Ia.

The revolving rack for over-hauling the 9½ ins. air pump or others, is to some extent an old idea, and many arrangements of this nature are in general use. It is, however, a fact that many such devices are built too light with a view to economy, or over-built with an exaggerated conception of what is demanded of the apparatus.

The accompanying sketch is descriptive of a pump rack, the parts of which are readily blocked, forged and machined. The length of the king bolt over the thickness of the wheel allows the wheel and attached pump to be turned and locked in any position convenient for working on the parts. The nature of the floor bracing makes it possible to locate the arrangement near the testing out rack. If the two are covered by an over-head rail and travelling hoist, the handling of pumps is made an easy matter.



AIR PUMP REPAIR RACK IN POSITION.



DETAILS OF AIR PUMP REPAIR RACK.

Panama Fair Opening.

According to advices sent to the railroads of the country, the great Panama Pacific Exposition at San Francisco will open right on time and be in nearly all respects the same as if there were no European war. February 20 is the official opening day of the big show. It will continue until December 4, 1915. The exposition is now 97 per cent. completed. In spite of the war, both Great Britain and Germany will have extensive exhibits. There are 42 foreign nations officially participating.

California's other exposition—The Panama-California Exposition at San Diego—opened on New Year's day and will continue for a year. All the exhibits are "in the making," rather than the finished product, in which respect the exposition is unique.

Air Brake Tests

By WALTER V. TURNER

First Article.

[illegible] AND [illegible] ADEQUATE TESTING.

[illegible] copies [illegible] certain instructions formulated by Mr. W. V. Turner for his engineering department, and in summing up conditions that make a test valuable or the reverse, the remarks were not intended for publication [illegible] test rack operators, nevertheless the portions printed below will be of value to anyone interested in testing brake apparatus.

The causes of improper and inadequate testing are numerous and various, for in[illegible]

False reasoning.

Insufficient information.

Failure to comprehend what is specified or desired.

Misunderstanding.

Ignorance of principles.

Ignorance of working conditions.

Trying to test several functions or changes at the same time.

Fallible observation.

Insufficient and inaccurate instruments.

Desire to make a showing of successful accomplishment.

Partiality and prejudice.

Overcrowding, or impatience, on the part of those desiring the information.

Failure to provide working conditions and many others of like character.

All of these show the importance.

(1) Of knowing the functions and capacity of the device.

(2) Of thoroughly comprehending and understanding the working conditions.

(3) Of thoroughly adequate experimenters and recorders, and,

(4) on the part of all concerned, the knowledge and understanding that a report of a test is not in itself a sufficient warrant that the device is all that is desired, for, in the last analysis, nothing but a certificate of having met the conditions of service efficiently and trustworthily is conclusive that the device is what is desired. The chances of the device doing this will depend very largely upon how near the "test" conditions approximate the working conditions.

[illegible] this dissertation is, in addition to whatever else may be started, to (1st) encour[illegible] [illegible] [illegible]erned that a test report may have limitations and that more than is intended or disclosed should not be read into it—[illegible] port being extended to cover conditions it does not; or for which it was not intended, or which was not specified that it should—(4th) to prevent the test report being taken as the last word, and thus the engineering department be deprived of a defence.

The following considerations may be of assistance in comprehending my po[illegible]

[illegible] clude all that is necessary to warrant action, that is, acceptance of the efficiency of the device, even though the device "passes" the test. It must first be known that the specification includes all the required tests both in quality and quantity.

[illegible] (that is, it does not give information to bank on) unless it includes all the conditions to which the device is to be subjected. The most that can be claimed for such a test is, that it is better than none and good only in proportion to the closeness with which it approximates the working [illegible]

(C) Thus the value of a test depends upon knowledge, experience, and the quality and quantity of this that the engineer puts into his test specifications.

(D) In the last analysis the quality of operation or performance of a device depends upon knowledge, experience, degree of thoroughness with which the designer employs these and his designing ability.

(E) All of this means that unless the designer knows all the conditions the device is to be "up against," he cannot devise or formulate a test which will assure that the device will "fill the bill," since (if the designer does not know) it [illegible] the "bill" [illegible] quantity.

(F) From this (paragraph E) it follows that the designer can only "set up" such a test specification as includes the factors or operation conditions included in the design (which must be short of what is required for the working conditions to be met), and (assuming material and workmanship to be what it should) it of necessity follows that the so-called test will prove that the device is O. K.

(G) As a matter of fact, neither the device nor the test can (under these conditions) be worth a "continental," as putting the device in service will prove.

(H) Thus we are back to paragraphs [illegible]

One cannot get more out of a device than is put into it. If one does not consciously put in all that is needed, only by accident can it be there.

As an aid to experimenting and testing, I offer the following.

Before *any* experiment or test *can* have its proper value, the following *principles* must be observed: *These* do *not* depend upon opinions or beliefs, since they fundamentally emanate from physical laws; that is to say, since there *is* a fixed relation between cause and effect, it *necessarily* follows that if one is to discover a cause, produce an effect, distinguish between cause and effect, or discover their relationship, it *must* be done according to the known principles, and in *proportion* as this is done will the *result* be of value.

Boiler Efficiency.

Few locomotives evaporate more than six pounds of water to each pound of coal consumed in the furnaces; the most efficient compound, stationary or marine engines, with the best design of boileer, very rarely evaporate more than 10 pounds of water to the pound of coal. These are undeniable facts, yet accounts of boiler efficiency are sometimes published that display gross ignorance or a desire to deceive. When a new type of boiler is offered to steam users, extraordinary claims are frequently made concerning the performance. A case is cited of a new furnace abroad which, it is said, evaporated 36 pounds of water per pound of coal, and another gentleman (a professor, be it noted) says that an ordinary boiler furnace evaporated 26 pounds of water per pound of coal. The improved furnace was one-third better than the common one, while the latter got twice as much energy out of a pound of coal as there was in it. People who say that engineering is not advancing will have to revise their statements.

Effect of Competition.

[illegible]hen Mr. J. F. De Voy speaks he [illegible]rally throws new light upon the [illegible]ct under discussion. While Fuel [illegible]omy was the topic, Mr. De Voy [illegible]rked: The Milwaukee road has a [illegible]rd of coal consumption on each [illegible]ion monthly, and if there is any [illegible] thing as competition showing in [illegible] consumption, the superintendents [illegible]ld go after each other and then [illegible] us, if we do not have things right. [illegible]ere is any locomotive using more [illegible] than other engines of the same [illegible] it is soon found out and given [illegible]ired attention.

Importance of Coal Economy

By ANGUS SINCLAIR, D.E.

Fourth Article.

OPERATIONS OF THE COMBUSTION OF SOFT COAL IN A LOCOMOTIVE FIREBOX.

The ordinary American locomotive firebox is a plain oblong box with grates at the bottom through which all the air provided for combustion must pass. When the engine is working a train over the road, a body of burning coal, eight, ten, or twelve inches deep, is kept covering the grates, the exact thickness of the fire being regulated by the taste of the fireman or his knowledge of what kind of a fire the engine steams best with. If the nozzles are as small as most engineers like to have them, or the grate openings are wide, the engine will steam best with a heavy fire. As the air passes through the grates where a heavy fire is habitually carried, the lower portion of the burning mass of fire catches the oxygen contained in the air, and the atoms of carbon that succeed in getting their full share, which is two atoms each, pass upward in the form of carbonic acid gas, the most efficient heat producing result of combustion. Further up in the burning mass are atoms of carbon that have been raised to a high temperature and whirling ready to grasp their share of oxygen. As the demand at this point is often less than the supply of oxygen, some of the carbon atoms succeed in getting only one atom of oxygen, but they take that and pass on as carbonic oxide. One pound of carbon combined with 2 2/3 pounds or two atoms of oxygen to one of carbon to form carbonic acid, generates 14,500 heat units; one pound of carbon combined with 1 1/3 pounds or one atom of oxygen to one of carbon to carbonic oxide generates 4,500 heat units. It will, therefore, be seen that it is not desirable to have the fuel products turned into carbonic oxide. On the top of the fire is a mass of green coal from which the carbureted hydrogen is being liberated. While one pound of carbon requires 2 2/3 pounds of oxygen for the chemical combination of combustion, one pound of hydrogen requires 8 pounds of oxygen. In our firebox the compound that requires the most liberal supply of oxygen to make it of any use is distilled at a point where the only oxygen to be had is polluted with all the gases that emanated from the lower part of the fire, or passed through the incandescent mass. And it requires ten cubic feet of atmospheric air to supply the oxygen needed for each cubic foot of carbureted hydrogen liberated from the coal, making twenty cubic feet of air for every pound of coal burned. Under these circumstances it is not surprising that the carbureted hydrogen in the tubes is unconsumed. Sometimes it seizes one of the atoms of oxygen that went to form carbonic acid, for oxygen has a strong affinity for hydrogen at high temperatures, and one of its atoms readily deserts carbonic acid for hydrogen, leaving the former to pass to the tubes in the shape of carbonic oxide, a repeating cause of wasting heat.

When attempts are made to provide sufficient air at the top of a deep fire by forcing it more rapidly through the grates, the ordinary effect is to increase the intensity of combustion in the lower portion of the fire without doing any good above. Locomotives operated in this fashion always smoke like coke ovens, and no pains are taken to direct attention to their record as fuel users.

[illegible] GRATES.

When a locomotive has ample heating surface when the draft appliances and grates are so regulated that an engine will steam freely with a light fire, say six or eight inches deep, the air may be passed through the grate fairly well to supply the volatile gases on the top of the fire with oxygen. Very few locomotives, however, with a plain firebox will steam with a very thin fire unless they be running light trains. Where a light fire successfully carried, great skill is necessary in firing. The coal must be supplied at frequent intervals and scattered evenly over the portions that the trained eye knows to be thinnest. There is danger of serious loss of heat resulting from thin firing just as much as the loss due to heavy firing. The grate area of fireboxes is becoming so large that it is a difficult matter covering every part evenly, and spots are apt to get so thin that they admit cold air that reduces part of the gases below the point of ignition, so they not only pass away unconsumed, but chill every point they strike. To effect perfect combustion, uniformly high firebox temparature is essential, and this high temperature is not easily maintained in all parts of a large firebox when every portion of the grate is being continually assailed by strong currents of cold air forced up by the speed of the train and drawn in by the suction of the exhaust.

[illegible] GRATE AREA.

The practice of supplying all the air needed to effect combustion in the whole [illegible] made thin firing essential if fairly economical use is to be made of the coal. The same practice has led to an increasing demand for increased grate area. If a portion of the air supply were provided in a proper way above the fire, it is doubtful if more economical results could not be secured by less grate area than is getting to be fashionable. With very large grate areas intensity of heat is sacrificed for the purpose of getting slower combustion per square foot of grate, yet the indications are that for burning soft coal the engines with the largest grates are by no means the most economical fuel users.

Cooling Water Without Ice.

To cool water without using ice get a slender glass test tube from any drug store. Half fill it with nitrate of ammonia salts, fill up with water, cork tightly. Shake till the salt is dissolved. Be careful to wipe the outside of the tube dry, in order that all traces of the nitrate may be removed. Place this tube into a glass of water and agitate as you would a spoon. The water is rapidly chilled. The nitrate of ammonia salts can be bought at any drug store. This is a far better way of cooling water than putting ice in it.

Against the Full Crew Law.

The Full Crew law [illegible] Pennsylvania appears to be inflicting hardships upon some of the railroads and certain officials are striving to have the law repealed or modified. Largely signed petitions have been circulated calling for the repeal of the law, but the railroad brotherhoods are opposing any change. Railroad officials who are striving to have the Full Crew law and other arbitrary measures repealed, should try to attain the help of the brotherhoods towards favoring the change.

Against Giving Help to Railroads.

Senator La Follette appears to be taking the part of a demagogue wherever railroad interests are concerned. He has introduced into Congress a resolution aiming to nullify the action of the Interstate Commerce Commission in its recent [illegible] per cent. on freight rates. Senator La [illegible] the laboring man, yet that individual is suffering more from the poverty of railroads than any other interest.

New Locomotives for the St. Louis, Brownsville & Mexico R. R.

The St. Louis, Brownsville and Mexico Railway (Gulf Coast Lines) have in service twenty Consolidation type locomotives, as shown in the accompanying illustration. These engines were built by the Baldwin Locomotive Works. They exert a tractive force of 34,000 pounds, and are oil burners using superheated steam. The road is comparatively level, but is laid with rails weighing 65 pounds per yard; and the engines are built to stand up under rough service conditions. Although these locomotives are comparatively moderate in size and weight, the design is up to date throughout.

The water used on this line is liable to foam; and the boiler, which is of the wagon-top type, with a tapered ring in the front of the barrel, is designed with ample steam space. The horizontal seams are butt-jointed and sextuple riveted, and have 90 per cent. of the strength of the solid plate. The front end of the crown is supported by four rows of flexible stays, and flexible bolts are used in the breaking zones in the water legs.

The steam distribution is controlled by 12-inch piston valves, which are driven by Walschaerts motion. The steam chest bushings and the piston and valve packing rings are of Hunt-Spiller metal. The driving-wheel centers and driving-boxes are of cast steel, the wheel centers being fitted with cast-iron hub liners. Grease lubrication is provided on the driving journals and crank-pins. The front truck wheels are of forged and rolled steel, supplied by the Standard Steel Works Co.

The tender is carried on chilled cast iron wheels, weighing 725 pounds each. The frame is built of 12-inch channels, and the water tank is U-shaped with a straight top.

The oil burning apparatus is of the standard type so successfully used on the Gulf Coast Lines.

The principal dimensions of these engines are are follows:

Gauge, 4 ft. 8½ ins.; cylinders, 21 ins. x 28 ins.; valves, piston, 12 ins. diameter.

Boiler—type, wagon-top; diameter, 65 ins.; thickness of sheets, 11/16 in.; working pressure, 185 lbs.; fuel, oil; staying, radial.

Firebox — material, steel; length, 114 3/16 ins.; width, 41¼ ins.; depth, front, 72 ins.; depth, back, 69 ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, 5/16 in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space—front, 4 ins.; sides, 3[illegible] ins.; back, 3½ ins.

Tubes—material, steel; diameter, 5⅜ ins. and 2 ins.; thickness, 5⅜ ins., No. 9 W. G.; thickness, 2 ins., No. 12 W. G.; number, 5⅜ ins., 22; 2 ins., 165; length, 14 ft. 0 ins.

Heating Surface—firebox, 177 sq. ft.; tubes, 1,633 sq. ft.; total, 1,810 sq. ft.; grate area, 32.7 sq. ft.

Driving Wheels—diameter, outside, 57 ins.; diameter, center, 50 ins.; journals, 9½ ins. x 12 ins.

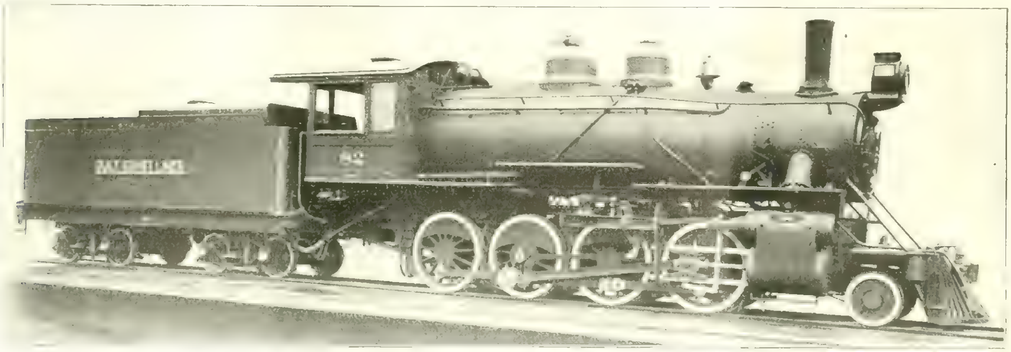
Engine Truck Wheels—diameter, 31 ins.; journals, 5½ ins. x 10 ins.

Wheel Base—driving, 16 ft. 0 ins.; rigid, 16 ft. 0 ins.; total engine, 24 ft. 6 ins.; total engine and tender, 49 ft. 7½ ins.

Weight—on driving wheels, 153,750 lbs.; on truck, 20,450 lbs.; total engine, 174,200 lbs.; total engine and tender, about 310,000 lbs.

Tender—wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, water, 7,500 gals.; tank capacity, oil, 3,000 gals.; service, freight.

Locomotive equipped with Schmidt superheater. Superheating surface, 341 sq. ft.



[illegible] LOCOMOTIVE FOR THE ST. LOUIS, BROWNSVILLE & MEXICO RAILWAY [illegible]
Baldwin Locomotive Works, Builders

Dining Cars, Southern Pacific Railroad.

Six dining cars lately built for the Southern Pacific Railroad illustrate some very modern features of construction. The general dimensions of the cars are 72 ft. 6 in. over end sills, 56 ft. 9½ in. between bogie centres, and 9 ft. 9⅝ in. wide over side sills. Each of the cars is furnished with ten dining tables at which thirty persons may be seated and served at one time. The interior finish of the cars is of wood throughout, the dining compartment being vermilion mahogany veneer with an artistic satin-wood inlay, and that of the kitchen being of stained birch.

Large Glass Switchboard.

In the power plant of Dodge Bros., Detroit, Mich., is a large 13-panel switchboard built by the Mutual Electric & Machine Co., of Wheeling, West Va., the panels of which are made of Carrara glass. Golden bronze finished electric instruments are mounted on the panels and the whole effect is very pleasing.

It has always been the practice to use marble or slate, free from metallic veins for switchboard panels and this departure is new. However, glass, as we all know, is an excellent insulator and in a slab 1½ inches thick (the thickness of these panels) it is strong enough to be perfectly satisfactory for use as a switchboard.

Training Locomotive Firemen.

Much intelligent attention has been devoted by the Traveling Engineers' Association to the training of locomotive firemen, and they are still pursuing the good work. One of the committees appointed will, at next convention, report on Recommended Practice for the Employment and Training of New Firemen.

Catechism of Railroad Operation

NEW SERIES.

Third Year's Examination.

(Continued from page 15, January, 1915.)

Q. 134.—What would you do if relief (vacuum) valve in steam chest broke?

A.—Would remove cap and clamp it on seat with block of wood or iron placed on valve and cap screwed down on it.

Note.—Many grease plugs will fit opening in steam chest where the vacuum valve screws into chest.

Q. 135.—What would you do if cap to vacuum valve blew out and was lost?

A.—Would remove vacuum valve cage from chest and plug it on inner end and screw it back in place.

Q. 136.—If when throttle was closed, steam showed at cylinder cocks, what might be the cause?

A.—It might be a leaky throttle or a leaky dry pipe.

Q. 137.—How would you test to determine whether throttle or dry pipe was leaking?

A.—Close the lubricator valves, and the air pump throttle if the exhaust from pump was tapped into cylinder saddles, fill boiler with water so I would have the dry pipe covered with water, have cylinder cocks open, and if dry steam showed at cylinder cocks the throttle would be leaking; if water showed with a little steam, would report dry pipe leaking.

Q. 138.—What would you do if the transmission bar hanger became broken?

A.—Support it with a chain or several strands of wire, if necessary would fit block above bar between strands of the chain or wire to prevent bar from raising up when lever was hooked up.

Q. 139.—What would you do if transmission bar were broken?

A.—It would depend on where bar was broken, if broken near rocker arm connection, would block valve central, support front end of bar with chain or wire, provide for lubrication and free circulation of air and proceed. If broken near link, would take down broken parts necessary, clamp valve centrally, provide for lubrication and circulation and proceed.

Q. 140.—Why is the throttle placed as high as possible in the dome?

A.—To get the steam at as high a temperature and as dry as possible.

Q. 141.—What are the cylinder cocks for?

A.—To free the cylinders of condensation.

Q. 142.—Why is it necessary to keep the cylinders free from condensation?

A.—To prevent knocking out cylinder heads, breaking packing rings, and washing off lubrication from walls of cylinder.

Note.—Water is not compressible and if left in cylinders when the piston moved towards the head, the water not being able to get out, and being solid would damage the head or packing rings.

Q. 143.—In what manner can both valves be placed on center of seat at the same time?

A.—Place engine on either quarter on one side and reverse lever in center of quadrant, go to the other side and disconnect lower eccentric blade from link, move the link until rocker arm is at right angles to valve rod, and you will have both valves central.

Note.—The above applies to the Stevenson gear; with the Walschaerts gear you will get the same results by placing engine on quarter and reverse lever in center of rack, then on the other side disconnect combination lever and move it until its upper end is at right angles to valve rod, and both valves will be central.

Q. 144.—Name the various causes for pounds.

A.—Loose or lost cylinder key; piston head loose on piston rod; loose follower bolts; piston rod loose in cross-head; main rod too long or too short; cylinder bushing loose and a little short; wrist pin loose in cross-head; rod brasses loose on pins or not keyed properly; pedestal binder loose; wedge down on binder or not properly adjusted; wedge not right taper; axle worn out of round, driving box brass worn large for axle; driving box broken; engine frame broken; cross-head loose in guides; knuckle pins or their bushings in side rods worn.

Q. 145.—When does the loose follower head pound the most?

A.—When drifting with throttle closed.

Q. 146.—When does the main rod too long or too short pound most?

A.—When drifting with throttle closed, because the weight of piston will take up all the slack in main rod and its connections and cause piston to strike the head of cylinder.

Note.—If main rod is too short piston strike back head of cylinder as crank passes back center, when drifting with throttle closed; if too long, the piston will strike front cylinder head as crank passes front center, when drifting with throttle closed. To protect cylinder heads, open throttle and the steam admitted to cylinder account of the lead will cushion piston and take up all of the lost motion in rod and connections, preventing piston head striking cylinder head.

Q. 147.—When does the loose piston head on rod, or piston rod loose in the cross head pound hardest?

A.—When working steam, and crank pins are passing centers.

Q. 148.—How do you locate the loose piston head or rod?

A.—It can be located when running along working steam; you will get a heavy pound when crank pin on defective side is crossing back center and a lighter pound when crank is crossing front center.

Standing test.—Place engine on top quarter on side you desire to test, open the throttle and work lever from one corner to the other of quadrant; if piston is loose you will get a heavy pound when lever goes toward the front corner, and a lighter pound when lever goes toward the back corner.

Note.—The piston head is taper fitted on end of rod and rod is taper fitted into cross head, consequently when steam is admitted back of piston, the piston moves away from the taper, and the farther it moves the less resistance it has, and it strikes the nuts on end of rod a hard blow; but when the steam is admitted ahead of piston it goes against the taper and is slowed down by friction so that it loses force so that it strikes the shoulder a very light blow.

Q. 149.—How would you be able to detect the loose cylinder bushing?

A.—This defect can only be located while engine is in motion and working steam. The pound occurs at each end of stroke of piston, just after pin passes the center and generally before it reaches the eighth.

Note.—The cylinder packing rings are expanded by the steam against the walls of the bushing, and the friction moves the bushing until it strikes the cylinder head.

Q. 150.—How do you test for cylinder packing blow?

A.—It may be located while running, and working steam; you will [illegible]

[illegible] the [illegible] after the crank on defective side leaves the center [illegible] eighth, and [illegible] closes communication between admission port and exhaust at other end of cylinder.

Standing test.—Place engine on top forward eighth, set brake and place reverse lever in forward corner of rack, block front cylinder cock open, admit [illegible] shows at front cylinder cock the cylinder packing rings are defective.

Note.—The reason for placing engine on the eighth for this test is that cylinder wears most from center to forward end and the rings might not [illegible] center.

Note. The old way for this test (and it is a good one). Place engine on top quarter on side you desire to test, reverse lever in front corner, set brake, open cylinder cocks, admit steam and if steam shows at front cylinder cock it indicates that packing is defective.

Q. 151.—Why is the link saddle pin [illegible] side of the center of link?

A.—To overcome the effect of the angularity of the main rod.

Q. 152.—Why have side (parallel) rods on mogul and consolidation types of engines, knuckle joints?

A.—To allow for the free movement of the wheels over uneven track, with[illegible]

Q. 153.—What are the pedestal braces (binders) of locomotives?

A.—They are a detachable portion of the lower frame rail, made of bars of iron or steel to bind the lower end of [illegible]

Q. 154.—How is a locomotive boiler attached to engine frame?

A.—The boiler is solidly attached to cylinder saddles with bolts, and the cylinder saddles are solidly attached to frame with bolts and saddle keys, and at the rear end the boiler is supported on frame by expansion plates which are [illegible] by hangers which are hinged on plates [illegible] frame.

[illegible] and forward easily on frame, and still [illegible] necessary arrangement because the boiler expands and contracts more than the frame does and these expansion plates or hangers guard against [illegible]

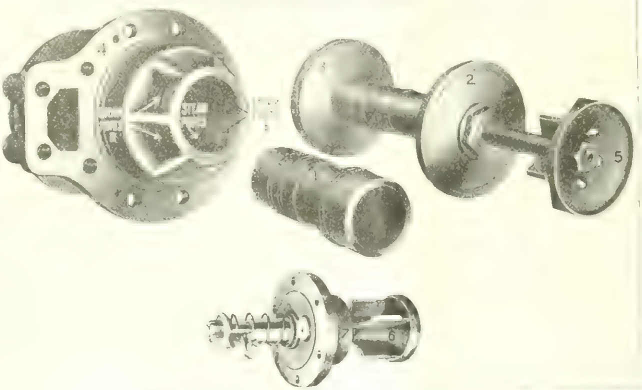
[illegible] the bolts holding the expansion plates are [illegible] fitted so that the expansion plate [illegible]

Questions Answered

[illegible]

G. K. P., Mechanicville, N. Y., writes: (1) What is a Mallet articulated compound locomotive? (2) How are the simple and compound features controlled? (3) Should the high or low pressure [illegible] you get the engine in? (4) Why should [illegible] to drift down grade? A.—(1) An articulated compound locomotive is one having two sets of cylinders, compounded together and driving independent groups of wheels. The two sets of cylinders are supplied with steam from a single boiler; it is practically two locomotives combined in one, and having only one boiler. The rear group of wheels is carried in frames rigidly attached to the boiler in the usual manner; while the frames which carry the front group of wheels are not secured to the boiler, but support it by means of sliding bearings. There is a hinged connection between the frames of the front engine and those of the rear engine, about which the former is permitted a limited swing in relation to the latter. The articulated type of locomotive provides a short rigid wheelbase capable of passing through curves of short radius, while the weight is distributed over a greater number of axles. An enormous tractive power is thus obtained with practically no increase in the weights of the moving parts over those of a locomotive of the rigid frame type having half the tractive [illegible] called the intercepting valve, which is located between the receiver and the exhaust passages from the high pressure cylinder. This valve shuts off at the proper time, communication between the receiver and the high pressure cylinders, to prevent the pressure in the receiver backing up against the high pressure pistons, when the locomotive is working with live steam in all four cylinders. The valve is located in the saddle of the left high pressure cylinder. It consists of three valves, the intercepting valve, the reducing valve or sleeve, and the emergency or high pressure exhaust valve. The emergency or high pressure valve, which is located at one of the outer ends of the intercepting valve chamber, is the device which makes it possible to change the locomotive from compound to simple working.

When the locomotive is changed into simple working, the emergency valve is opened, which allows the exhaust steam from the high pressure cylinders to pass through a wrought iron pipe to the exhaust pipe in the smoke box and to the atmosphere. The opening and closing of the emergency valve is effected by a simple valve located in the cab, a handle pointing forward when the valve is closed and the locomotive working compound, and the handle pointing backward when the locomotive is working simple with the valve open. (3) In case of any breakdown in which one or more of the cylinders can be disconnected and the locomotive run in with the remaining cylinders active, simply throw the emergency operating valve in the cab into the simple position and proceed as with a simple locomotive, disconnecting and blocking the disabled cylinder or cylinders. (4) When drifting, the reverse lever should be kept at three-quarter stroke or more. If this is done, the locomotive will drift freely. Another important feature of the articulated compound locomotive is the by-pass valves, their purpose being to prevent the [illegible] effects which would otherwise



[illegible]

[illegible]
3. Dashpot Piston [illegible]
[illegible] Intercepting Valve Chamber Head
[illegible] Valve
[illegible] of High Pressure Exhaust Valve
[illegible]

result from the pumping action of the large low pressure pistons when the locomotive is drifting. These valves are so designed that they automatically establish communication between the two ends of the cylinder, when the engine is running with the throttle closed.

It should be noted that the brief answers to the above questions refer largely to the Mallet locomotives as constructed by the American Locomotive Company, and the illustration is a section of details furnished by that company.

HANDLING BRAKE VALVE ON SECOND ENGINE.

J. H. B., Youngstown, Ohio, writes: Has the second engineer of a double header any part whatever in the handling of the train brakes after his brake valve is cut out and the train is in motion? A.—Yes, in case of an emergency that might not be observed by the first engineer, the duty of the second engineer would be to quickly place his brake valve handle in emergency position and open the stop cock in the brake pipe which will apply the brakes in quick action throughout the train. The instant the train has stopped or the danger has passed the cut-out cock should again be closed and the brake valve returned to running position, as the application of the brake from an unknown cause will prompt the first engineer to place his brake valve on lap position, or in emergency position if handling a passenger train, and thereafter he will release the brake and assume control of the train.

There are also other conditions under which the second man may have some part in the successful handling of train brakes, as in the event of a release of brakes at moderate rate of speed on a long freight train where in many instances the second man may materially assist the first man and the K triple valves at the head end in holding in the train slack by placing either of the brake valves on lap position as the exhaust from the distributing valve starts when the first man moves his valve to release position. This movement will hold the brake on the second engine which should be gradually released as the first engine begins to use steam.

There are conditions under which the second man could render expert assistance in making a service stop with a freight train, and there are circumstances arising wherein the second man can use his brake valve to advantage, but they cannot be commented upon in a general way, in fact they should not be attempted unless both engineers happen to be air brake men. As to the use of the brake valve cut-out cock, from a viewpoint of safety first, it is best to be governed by the instruction to close the cut-out cock and leave it closed until the head engine cuts off, as noted however, a case of emergency will permit of a variation of this rule.

RELEASE OF K TRIPLE VALVES.

J. H. B., Youngstown, Ohio, writes: When the K triple valve moves to restricted release position, it takes considerably longer for the brake cylinder pressure to exhaust than when the valve is in normal release position, and with very short trains or in shifting a few cars this is sometimes quite annoying to be compelled to wait for the brake to become entirely released. What is the general practice followed in handling these valves under this condition? A.—We believe that the general practice is to wait for the complete release to take place or to drag the cars with the brakes partially applied, however, if you will, under the stated conditions, move the brake valve handle back on the shoulder between lap and holding positions instead of to release or running position for releasing the brakes on a very few cars with K triple valves, you will find that with a little practice you can find a place on this shoulder for the handle latch that will give a slow rate of rise in brake pipe pressure that will not force the valves to restricted release position, but after any ordinary service reduction, will only move them to normal release position in which they will release as promptly as the type H valves.

You will understand that this is merely in the nature of a suggestion, for obviously if the brake pipe pressure is not increased three pounds or more above the pressure in the auxiliary reservoir, the spring of the retarding device cannot be compressed and the triple valve cannot assume restricted release position.

BRAKE INSPECTION.

T. M. Havre, Montana, writes: Please describe the best way to test out the air brake system on an engine just out of the shop, after the pump, gauges, brake valves and governors have been overhauled. Engine equipped with the New York B-3 brake? A.—If the valves have been tested on the shop racks after being repaired, there should be nothing left to do beyond knowing that the pipes are properly connected and free from leakage then the governors and controllers should be adjusted and the piston travel corrected.

If however, these parts have not been tested on shop racks a more thorough test on the engine will be required, and a detailed account of how each valve should be separately tested would fill a small volume, but the principal points to be observed are, that there is no leakage from any of the apparatus or the piping, and that leakage from the waste and relief ports is not excessive: the governor must be sensitive to permit the pump to start promptly upon a drop in main reservoir pressure and the controllers, especially the brake pipe must be sensitive to supply any leak that occurs and permit of no variation of over 2 or 2½ pounds in pressure. It should be observed that the brake valve exhaust cuts off promptly after being placed on lap following a brake pipe reduction, and the brake must apply upon a 3 or 4 pound reduction and remain applied.

The hand wheel of the controller can be screwed up to equalize the pressures and if the gauge is correct both hands should show the same. The pump also must receive some attention if it has not been tested out in the shop.

You will of course understand that it is very unsatisfactory and exceedingly poor practice to attempt to test out any air brake valves without the standard shop racks, not that a man cannot do this and under certain conditions "get by," but for modern conditions these racks are absolutely indispensable.

Improvements on Dominion Atlantic Ry.

The record of improvements effected on the Dominion Atlantic Railway, which the Canadian Pacific Railway leased in 1911 for 99 years shows that new wharves have been built; 45 miles of new track have been ballasted; 30 miles of new 85 pound rails have been laid down; 120 cattle guards have been filled and replaced by surface guards, while dozens of bridges have been either improved or rebuilt. In round figures, 6,000 feet of wooden bridges have been replaced, or will be replaced very shortly, by steel bridges, concrete arches, and rail top culverts. New brick stations have been built; a general renovation has taken place, costing many thousands of dollars. The new stations include those at Wolfville and Annapolis Royal, Mosherville, Patterson and Iberville. During the past two years 35 stations have been repaired and painted and platforms have been erected. A new line from Centreville to Weston, 14 miles in extent, has been built in the most substantial manner. Both permanent work and the lighter things which needed attention have been carried out, and today the old Dominion Atlantic [illegible] taken on a new lease of life.

Something may soon be doing in Alaska in the line of railway construction, for a corps of locating engineers sent by the United States Government to make preliminary surveys, have returned and made a report to President Wilson. As the president is known to favor railway building in Alaska without delay, we may expect soon to hear of dirt flying.

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Development of Tools.

Most mechanics feel an interest in the development of the tools they use, for [illegible] on the means of increased production. The first tool or aid to man's power was naturally a crude form of hammer com- [illegible] handle. Then the necessity became pressing of means for boring holes and a crude form of gimlet was invented.

Pliny states that Dædelus invented the gimlet 1240 B. C., but we believe that a tool of that kind was used in Egypt many years earlier. Awls have been found in [illegible] 2700 B. C. [illegible] point was added to the gimlet in course of time, and within our own time the twisted shank. The auger was a Greek tool, but it was merely an enlarged gim- [illegible] tool. It formerly had a curved, sharpened end and a concavity to hold the chips. To this a lip was subsequently added for some kinds of boring. The twisted auger is an American invention and was made by Lilley, of Connecticut, about the beginning of last century.

The lathe, one of the oldest tools in use, was a remarkably crude apparatus when first introduced into our machine shops, which was about the beginning of last century. It had merely two dead centers which supported the work as it was rotated backward and forward by a band around it, the other end to the foot of the operator, while the turning tool was held in his hand. The next improvement on the lathe was providing it with a revoluble spindle and center by which the work was axially supported and rotated, the tools for turning wood or iron being held and manipulated by hand. For many years watch makers and mathematical instrument makers had used a simple form of slide rest to secure accuracy, but ordinary mechanics accustomed to the use of hand tools, in their pride of skill, despised anything in the form of a slide rest. But with the development of engineering resulting from the use of the steam engine, the demand arose for many large cylindrical iron pieces, exactly parallel and of accurate diameter, which hand skill could not produce, and so the slide rest forced itself into reluctant use.

In an article contributed by William Sellers to *The Americana*, he says: "The facilities for producing the long flat and straight surfaces best adapted for the slide rest were limited to the hammer and chisel and the file and straight edge, so that the slide-lathe had a curious development. The hand lathe, with its wooden bed and short slide rest, could produce cylinders economically and these were used for slide lathe beds, but lacking stability, as well as security for the slide rest, the cast iron bed dressed by the cold chisel and the file was finally adopted. The form of the guiding surfaces of the slide rest was, however, modified in the lathe to save hand labor, and this form has maintained its existence to the present day.

"The next development of the slide rest was the planing machine, whereby the rough, irregular surface of the castings and forgings, traveling slowly under a cutting tool, movable at right angles to the travel of the work, was smoothed and reduced to a true plane. The advent of this machine was an era in the life of the machinist, as great, perhaps, as that of the slide rest. It is uncertain when the first one was started, but in 1838 there were [illegible] in the United States.

"The drill, which before that time had been limited to a revolving spindle, had an iron frame added, and a table at right angles to it, upon which the work might be rigidly supported and adjusted with ease and certainty. The boring mill, or vertical lathe, was then economically possible and took its place in the machine shop to execute a large class of turned work that did not require to be supported on centers."

These tools formed the staple appliances used in our early machine shops and formed the foundation for the vast variety of productive apparatus now in use. Among the appliances that appeared later were the milling machine and all the devices employed in the forming and finishing screws of all kinds.

Erie Scheme of Fuel Economy.

Nearly all railroad officials strive to have their motion power operated as economically as possible, but few of them reach the success attained by the Erie Railroad. This may be because the men doing the work fail to respond to the demand of the officials, but we incline to think that the official immediately in charge of operations is active.

During the numerous journeys which the writer makes over the Erie Railroad he is always watching for signs of efficiency, and in doing so frequently compares the appearance of Erie locomotives with those of neighboring roads, always to the credit of the Erie engine. This is particularly striking in the absence of smoke. Smokeless firing may or may not save much fuel, but it is always evidence of careful firing, and Mr. H. C. Hayes, superintendent of locomotive operation, has reason to be proud of the way the men under him carry out his policy.

Mr. Hayes, however, is not entirely satisfied with the success of his management. Some time ago a saving of $30,000 in fuel on one division was achieved and Mr. Hayes is now demanding that similar or even improved results must be made on every division of the road. The challenge issued to the engine crews is a novelty and is in the nature of a proposal that they strive to return to the company through fuel saving and otherwise an economy representing 6 per cent. a fair interest on the sum which the company expends annually in paying their wages, which amounts to about $4,117,500. This would amount to a saving of $247,000 annually.

The greatest difficulty with Mr. Hayes' proposition is in its novelty. The figures look large and almost impossible of achievement in the fuel bill alone, but he reminds them that were each fireman to save one scoopful of coal, 15 pounds, per engine mile, which does not seem at all an unreasonable accomplishment, the total savings at the end of a year would be 337,500 tons—worth $523,125—more than twice the amount represented by the proposed 6 per cent. saving on the total of engine crew wages. Another deduction

which he makes in issuing this challenge, and one which can hardly fail to leave its impress on the minds of the crews, is the conclusion which has been arrived at through careful investigation, that each of the roads locomotives discharges in the form of steam through the safety valves, the equivalent of 7,000 pounds of coal per month, a total of 42 tons per engine per year, or 67,000 tons for the entire road during the same period, amounting not only to a loss of $100,000 for the road, but represents a corresponding waste of water and just that much superfluous work for the men in having handled those quantities of water and coal to no purpose.

These factors have nothing to do with the quantities of oil and tools which every crew can economize on without difficulty practically every day of their lives, nor of the tremendous savings that would result from more careful handling of machinery and equipment. When the enginemen of the Erie Railroad arrive at a realization of the fact that the 6 per cent. Mr. Hayes asks for can be saved through effecting actually less than 40 per cent. of the economies he shows to be reasonable in the coal account alone, they must be indifferent even to their own best interests, not to give him a wholehearted response that will result in more than meeting his best expectations.

Underpaid Railroad Officials.

The American Society of Civil Engineers has had for years a committee investigating the conditions of employment throughout the country of civil engineers. The records collected show that the civil engineers are fairly well paid, those in railroad service receiving about $3.500 annually, the compensation from railroads being higher than that paid by the National Government or by municipalities.

We are pleased to note this movement on the part of the civil engineers and should much like to see other technical societies take similar action for other men filling responsible positions. The members of the American Railway Master Mechanics' Association are by no means well paid, but we should like to see them start an investigation into the compensation paid to railroad shop foremen, including engine house foremen. For the responsible duties performed we consider shop foremen the worst paid officials in the country. Their duties are very arduous and their responsibilities great, but the importance of these receive little consideration when compensation has to be settled. We respectfully urge some enterprising master mechanic to ventilate this question.

The Tanner Brake Frauds.

We have repeatedly commented upon claims made on account of patents that were worthless, the victims generally being railway companies. Before the railroad associations were formed nearly any rogue possessing sufficient assurance could make railway companies pay royalty on fraudulent claims to avoid the expense of a threatened lawsuit.

There were many cases of that character, but the worst one is known as the Tanner Brake case.

Some time in 1846, Batchelder & Thompson, of Lowell, invented a car brake to be operated by the crowding of cars against each other, by means of a long bar located under the center of each car. It was a wretched contrivance and never came into use. They applied for a patent in 1847, but from various causes of delay the patent was not granted until July, 1852. In the meantime the Hodge and the Stevens brakes had both been invented and patented, one in 1840 and the other in 1851. In 1847 Willard J. Nicholls invented an apparatus which was afterwards known as the Tanner brake. Nicholls did not apply for a patent on his invention. In 1848 a person named Turner secured a patent for a double brake bearing some resemblance to the Batchelder & Thompson, and the Nicholls' brake being a bumper brake and hand brake combined.

Now begins a romance of claims based on brake inventions. In 1857 Henry Tanner, of Buffalo, bought the Turner brake patent and began going about the country trying to push it into use with no success. In the course of his travels Tanner came across the Nicholls brake, and finding it superior to the Turner, he abandoned the latter and adopted the Nicholls in its place. As there was no patent on the Nicholls brake, and a patent was necessary, Tanner determined to reissue the Turner brake patent with a claim that would include the invention of Nicholls. But on going to Washington for that purpose he learned about the application of Batchelder & Thompson. He bought out the Batchelder & Thompson interests in their invention and substituted in their place a new set of specifications to suit the Nicholls, and in July, 1852, a patent was issued, not for the bumper brake but for the hand brake of Nicholls, after that known as the Tanner brake. Tanner now claimed that his brake antedated the Hodge and the Stevens brakes and was prepared to enforce the payment of royalty from all roads that had been using these old time inventions.

His first victim was the Erie Railroad, which was mulcted $439, then the Hudson River road was assailed and settled for $1,000. At this point Thomas Sayles purchased all interest in the Tanner brake patent and proceeded to push them for all they were worth. Many railroad companies now began to pay for licenses to use the Tanner brake, and those that failed were promptly sued. Among the latter were the Philadelphia, Washington & Delaware. The verdict eventually given in the state court was for $350 per car per year, the total amounting to $70,000,000. Appeal was now made to the Supreme Court where the decree was reversed in 1878. Sayles, however, continued his prosecutions. Among other railroads prosecuted was the Chicago and North Western, against which heavy penalties were adjudged which Sayles offered to settle for $15,000,000 and passes. Sayles died shortly afterwards and his heirs settled for $500.

Several other suits were brought against railroads by parties claiming an interest in the various patents. The last of these was brought against the Lake Shore & Michigan Southern Railway in 1879 and was dismissed, which ended the amazing litigation.

Losses of War.

Like many other people we have believed that the European war would stimulate American trade and throw open to our industries markets that were formerly supplied by the people now engaged in human slaughter. While the warring nations are busy dissipating the wealth of the world, the opportunities for those following the ways of peace and industry are greatly magnified. Those who profit from increasing business due to their rivals being on the warpath should not build much on their increase of trade, for it is likely to be lost when normal conditions come round again. We have known of manufacturing concerns expanding their buildings and equipment to meet the temporary demand of war times, and then suffer for years for want of business to keep the enlarged plant going.

War in any country, while first endured in its intensity by the combatants has eventually to be paid for by the world at large. No nation can now-a-days live on itself alone so none can escape the assessment of loss.

Stop, Look and Listen.

If any person of observant habits will stand near a railway road crossing for half an hour and watch how little care is exercised by drivers of vehicles to avoid accidents, he will not be surprised that vehicles are frequently struck by trains, but the wonder will grow that collisions are not more frequent. Many railway companies exhibit in conspicuous letters the advice "Stop, look and listen," but that help to safety is habitually ignored, especially by the drivers of motor cars. We are consequently less than surprised at the following announcement:

Highway railroad grade crossing accidents last year cost 199 lives in New [illegible]

[illegible] 1912. The annual report of the National Highways Protective Society shows these figures for the year and does not include in the compilation those who were trespassing on railroad property. One hundred and thirty-three are shown to have been seriously injured, of whom 66 per cent. were pedestrians.

Analysis of the fatality list shows that thirty-five persons met their death while crossing tracks in automobiles, as compared to thirty-eight in 1913 and fifteen in 1912. Persons riding in wagons across the tracks and who met their death were thirty-one, as compared to thirty in 1913 and forty in 1912.

The report declares that not a single fatality is recorded as the result of trolley and train collision throughout the year, the strict law on the subject of stopping at a crossing being held responsible.

The railroad companies in making their annual reports show that carelessness is still rampant. One company maintains that during the year no less than 95 automobiles were driven right through railroad crossing gates, and it is claimed 70 per cent. of the cases happened within the limits of Greater New York.

The list shown by several of the railroads proves the New York Central to have cost 38 lives in grade crossing accidents. Some of the others are:

Long Island Railroad, 23; Erie Railroad, 16; Pennsylvania Railroad, 8; Delaware and Hudson, 8; Lehigh Valley Railroad, 8; Delaware, Lackawanna and Western Railroad, 7; Rome, Watertown, and Ogdensburg, 6; West Shore Railroad, 5; Nickel Plate Railroad, 5; Ontario and Western, 4; Buffalo, Rochester, and Pittsburgh, 3; Staten Island Railroad, 2; Boston and Maine, 1; Lake Shore and Michigan [illegible], 1.

Rust.

We are all familiar with the coating known as "rust," but knowledge concerning its formation and means of prevention is not so widespread as might be desired. According to Webster, rust is a reddish-yellow coating formed on iron when exposed to moist air, consisting of ferric oxide or hy-[illegible]

A scientific lecturer expounding the subject of rust remarked that if they [illegible] [illegible] of rust, they must begin by studying the conditions under which rust [illegible] as possible about the phenomenon itself. The question raised was, Is it the chemist or the engineer who should [illegible]

The answer in this case is like so many others—the two lines of investigation must work together in order to combine theory and practice.

Rust is, of course, a general phenomenon, said Professor Smithells lecturing on rust. It is not restricted to iron, but is more noticeable on iron because iron is the most abundantly used metal, because the rust of iron forms rapidly, because it assumes a scaly character, because of its color, and because of the fact that rust is a thing that appears to grow in the case of iron, and it does not grow so rapidly or abundantly on other metals. With a very few exceptions, all metals are subject to rust, but the rusting is very slight compared with that of iron. Iron rust is found to consist of three elements—iron, oxygen and hydrogen. That rusts are oxides could be easily proved because we can produce rust by the burning of metal in oxygen [illegible]

What is the cause of iron rust? Investigators all know that rusting was favored by the presence of air and moisture, but the question comes up, which of those two is the active agent, whether both are necessary and whether anything else took place in the process. They all knew that rusting was favored by the presence of the air, and by the presence of moisture, but they wanted to know which of these two was the active agent, whether both were necessary, and whether anything else took part in the process. They wanted to know why rusting went on so rapidly at different points, and how it was affected by the different composition and qualities of the metal, and by impurities in the metal, in the air, or in the water. Professor Smithells then showed some specimens of iron in jars, which he had been preparing for some time. One was a piece of iron in dry oxygen, and he explained that it [illegible] the iron to rust.

Next he showed a piece of iron [illegible] some days, remarking that it was found that when they excluded air and other gases from the water no action took place, and a second conclusion was that water alone would not affect iron. The next question was—would air and water together affect iron? That experiment had been tried, and it had been shown that, wherever action had taken place at all, the action had been exceedingly insignificant, and the question arose, what was it that was absent and that caused the rust? The one ingredient which was present in one of the jars, and was not present in the cases he had shown, was carbonic acid gas.

Carbonic acid gas existed in the atmosphere to a small extent, and it was this gas in the air that was all important in the operation of rusting. Pure air, pure water, pure carbonic acid would not act singly upon iron; pure water and pure air would not act together upon iron; carbonic acid and air would not act upon iron, but when they had carbonic acid, water and air together, they got rust. It was carbonic acid that really set up the rust action, and when it was formed, the carbonic acid was liberated and attacked the layers beneath. That was why rust had got the property of traveling inward. How could they prevent this action of rusting? There were many things which had been tried. They might paint the iron, and if they observed certain precautions, they might have an effective method.

Protection of British Railways.

When railways were first introduced into the British Isles great opposition was manifested against them and very exacting laws were passed for their regulation. But as an offset to that decidedly fair laws were passed for their protection. The dangerous nuisance that American railroads suffer from of people trespassing upon the right of way is unknown in Britain because the law makes it a crime to trespass upon the right of way of a railway.

One of the commonest forms of malicious mischief in this country is that of boys, and even men, placing small obstructions, such as stone, wood, rocks and splice bars on the track to see how they would make the locomotive jump. We have even known of a farmer driving an old worn-out horse into a cattle guard with a view of making an involuntary sale of the animal to the railroad company, and then go off to a distance and watch its effect on an approaching train. If the Draconian law in force in England against such offenses prevailed here amusements of this dangerous character would be indulged in at more risk to the joker. An English paper recently reports the case of a boy who was tried for placing an obstruction upon a railway track. The judge mentioned that the criminal was liable to penal servitude for life, but owing to his tender years he sentenced him to one month's imprisonment and to be well [illegible] with a birch rod.

Efficiency of the Locomotive.

We have always maintained that the [illegible] well designed properly operated locomotive, was much higher than the engine is generally credited with, but we must confess surprise at the figures given by a committee of the American Society of Mechanical Engineers consisting of Messrs. G. M. B[illegible] and F. H. Clark and W. F. Kiesel Jr. Part of the report reads:

[illegible] comparisons may be drawn

from the best results of ten years ago and of today. At the Louisiana Purchase Exposition in 1904 the tests made by the Pennsylvania Railroad revealed important figures concerning locomotive performance at that time. It was shown to be possible to obtain equivalent evaporation from and at 212 degrees of 16.4 pounds of water per square foot of heating surface, indicating the power of locomotive boilers when forced. It was shown that when the power was low, the evaporation per pound of coal was between 10 and 12 pounds, whereas the evaporation declined to approximately two-thirds of these values when the boiler was forced. These results compared favorably with those obtained in good stationary practice, whereas the rate of evaporation in stationary practice lies usually from 4 to 7 pounds of water per foot of heating surface per hour. In steam consumption the St. Louis tests showed a minimum of 16.6 pounds of steam per i. h. p. per hour. In coal economy the lowest figure was 2.01 pounds of coal per i. h. p., the minimum figure for coal per dynamometer h. p. was 2.14 pounds. These records were made after the superheater had become a factor in locomotive practice and they represent economies attained by aid of the superheater in one of its early applications. This is important in the light of the recent development of the superheater. These remarkable figures have never received the attention which they deserve from engineers. They serve, however, to show that 10 years ago a steam locomotive had attained results which were worthy of the best attention of the engineers of the time. Since then greater progress has been made and today locomotives of larger capacity than those concerned in the St. Louis tests have given better results.

Voluminous records of recent investigations of locomotive performance taken from the Pennsylvania Railroad test plant at Altoona show, that the best record of dry fuel per i. h. p.-hour down to the present date is 1.8 pounds with a large number of less than 2 pounds, while the best performance in dry steam per i. h. p.-hour is 14.6 pounds with a large number less tha 16 pounds. A reduction of 10 per cent. in fuel and 12 per cent. in water is remarkable as a result of a development of 10 years. This coal performance was recorded by a Class E 6 S Pennsylvania Railroad locomotive while running at 320 r. p. m. and developing 1,245.1 i. h. p. The same locomotive gave a fuel rate of 1.9 pounds while running at the same speed and developing 1,750.9 i. h. p. The best water rate was given by Class K 2 S A Pennsylvania Railroad locomotive while running at 320 r. p. m. and developing 2,033.1 i. h. p. These high powers indicate that the locomotives were not coddled as to output of power in order to show high efficiency, but that high efficiencies accompany actual conditions of operation in severe service. As to power capacity expressed in terms of evaporation, it is interesting to note that the maximum equivalent evaporation from and at 212 degrees per square foot of heating surface per hour on the Altoona test plant is 23.3 pounds. These figures of high efficiency were obtained from locomotives which represented not only very careful, general and detail design, but their design included several of the improvements making for greater capacity and higher efficiency, without which the results could not have been attained.

Having in mind the facts that steam locomotives are power plants on wheels, built to meet rigid limitations of weight, both static and dynamic, and that the use of condensers is impossible, engineers in general must admit the high character of the work of locomotive designers which has attained these results.

Greater efficiency, which is revealed on the test plant and through reports of engineers, would be important because it proves that progress is being made in the possibilities of locomotive performance. Improvement which is revealed by operating statistics and which, therefore, appears in the records of the treasurer's office is the real test in this case. It is important to know that increased power of locomotives attained largely through the development of economy producing and capacity increasing factors has produced results which the financial reports of railroads prove beyond question. A recently published list of train tonnage on 45 prominent railroads indicates that 16 of these roads have increased their average freight train loads by over 30 per cent. during the last five years. Credit must be given to the improvement in the locomotive for most of this development. These figures reveal the value of increased power and efficiency of steam locomotives and the end is not yet in sight.

To Prevent Destructive Fires.

The British Fire Prevention Committee have issued a report on a test they carried out on a partition made of wood which had been impregnated by the Oxylene process with the object of making it fire-resisting. The partition measured 10 feet by 9 feet, and its head, sill, side posts, and intermediates were constructed of 2-inch by 1⅞-inch deal, each side being covered with ⅝-inch grooved, tongued, and beaded boarding in 5-inch widths. It was submitted for 45 minutes to temperatures that rose to 1,630 degrees F., and then water was pumped upon it from a steam fire engine. According to the official observations smoke appeared through the [illegible] 38 minutes, and scorching was noticed at several joints two minutes later, while after 44 minutes a glow was visible at four joints. Water came through several of the joints, when at the end of the test the hose was turned upon the partition, which, however, remained in position. Although the resistance of the woodwork did not last long enough by a few minutes to enable the partition to be classed as affording "temporary protection," under the committee's standards, a note prefixed to the report states that the test demonstrates that the impregnating process employed has a retarding effect on combustion, and that timber so treated should be a valuable addition to the stock of fire-resisting materials. The process consists in submitting wood to a course of steaming, vacuum, and pressure, whereby the sapwater, air, and moisture are removed and replaced by a chemical solution which is preservative, antiseptic, non-hygroscopic, and non-corrosive. The water of this solution is then evaporated by placing the wood in drying kilns, the chemicals being left embedded throughout the fibres of the wood in minute crystal form. On the application of heat the crystals expand and form a glassy coating to the wood, this coating excluding the oxygen of the air and preventing combustion.

Shop Foremen's Duties to Workmen.

The best thing for any foreman to do is to tell his man what he wants done, and, if necessary, when it is to be finished; in case he has any doubts as to the man's ability to perform the work successfully, he should ask him to describe how he is intending to do it, and if the foreman discovers any flaw in the plan, he should show the man where he is wrong, and they should come to some definite conclusion together; good suggestions ought to be received in the same spirit they are given; it is a matter of courtesy.

Railroad Statistics.

The New York, New Haven & Hartford Railroad's Press Bureau publishes an interesting statement in regard to the financial condition of railroads in America. It appears that at the end of 1914 there were 21,048 miles of steam railroad in the hands of receivers, with a total outstanding stock of $434,599,738, and total funded debt of $830,728,790. During the year 1914, twenty-two roads, with a total mileage of 4,222, outstanding stock amounting to $62,321,150, and funded debt amounting to $137,250,296, were placed in the hands of receivers. The mileage in the hands of receivers at the end of 1914 was the greatest at any time since 1896.

Air Brake Department

Operation of Control Valve.

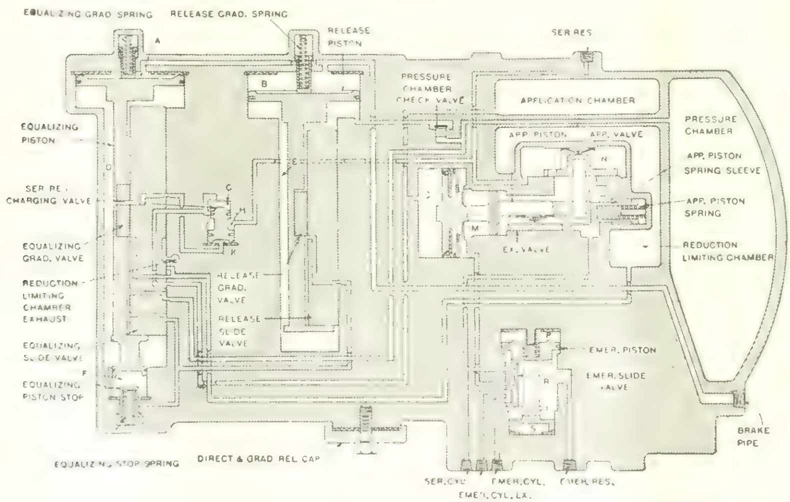
[illegible] explanation of the operation of the control valve proceeded as far as over-reduction position, which means that in this position the brake pipe reduction has passed the point at which the pressure and application chambers equalize. This has been mentioned to be 86 lbs., and the brake pipe reduction necessary is 24 lbs., hence the brake pipe hands on the gauges will at this time show 86 lbs. in the brake pipe.

If the brake pipe reduction is then continued until the difference in pressure between the pressure chamber and the [illegible] the equalizing piston graduating spring, the equalizing piston will travel its full stroke and make an opening from the pressure chamber to the reduction limiting chamber instead of the application chamber. The release piston graduating spring being somewhat heavier than the equalizing piston spring, the release piston will not travel its full stroke.

Any time the brake pipe reduction should cease, the equalizing piston and graduating valve would cut off the flow of pressure chamber air to the reduction limiting chamber, and assume over-reduction lap position, also in this position there are a number of minor connections which will not be dwelt upon more [illegible] the [illegible] valve maintains any leakage in the application chamber at this time, and if the reduction in brake pipe pressure is continued, the pressure chamber will equalize with the reduction limiting chamber and when the difference between the pressures in the brake pipe and the pressure and reduction limiting chamber is sufficient to compress the release piston graduating spring, the release piston will travel its full stroke and result in an emergency application as will be explained later on.

Regardless as to any position of the operating parts of the control valve, whenever the brake pipe pressure is increased above that in the pressure chamber, the equalizing and release pistons and their attached valves start toward release position. The equalizing slide valve being designed to move upon a trifle less differential than the release piston and slide valve, it may be assumed that the equalizing piston moves first to preliminary release position wherein the equalizing piston comes in contact and is held by the equalizing stop spring. The pressure chamber is also connected by the equalizing slide valve with the equalizing stop spring chamber, and as the equalizing slide valve stops here it opens the release slide valve chamber to the atmosphere through the reduction limiting chamber exhaust and the position which is but momentary, insures a drop in pressure in the release slide valve chamber for the positive return of the release piston to release position, and the opening of the application chamber to the atmosphere for the release of the brake.

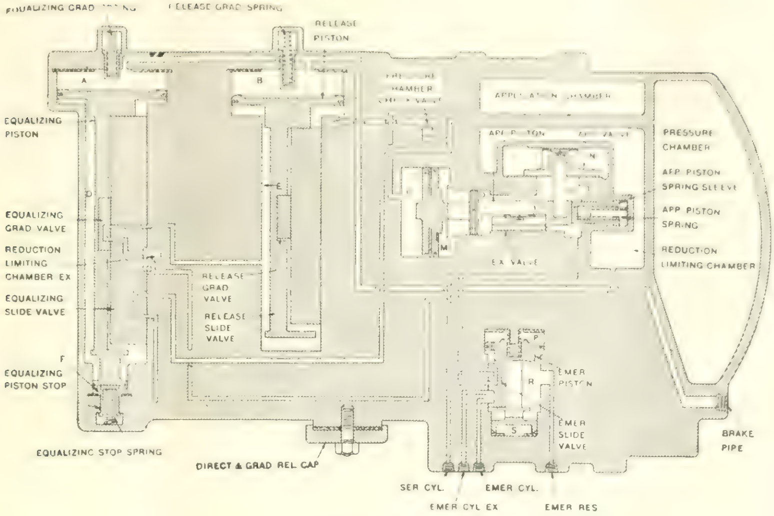
The release slide valve now moving to the secondary release position opens the chamber at the outside of the small end of the equalizing piston to the atmosphere through the emergency piston exhaust port, when the equalizing piston can move toward its lower position gradually cutting off the flow of pressure chamber air to the equalizing piston stop spring chamber and assuming release position



[illegible]

It must be understood that these positions are but of momentary duration, as when watching the operation of the control valve it will be noted that the start of the release of the brake is practically simultaneous with the movement of the brake valve handle, but whether the release piston and slide valve remains in release position, or whether it is forced back to graduated release position depends upon the position of the direct and graduated release cap and the manipulation of the brake valve handle.

If in direct release position, the release piston will move the release slide valve to a position as explained at the extreme end of the stroke, where it will remain and the application chamber pressure, and

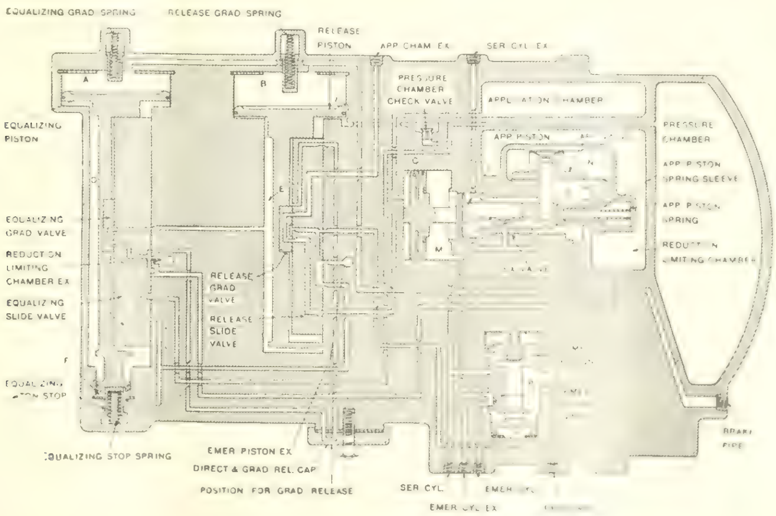


PRELIMINARY RELEASE.

consequently the brake cylinder pressure will escape through two different ports without any interference, and the release will be straight away, as with the ordinary quick action triple valve. If the graduated release cap is in graduated release position the same movement of the release slide valve toward release position will permit a flow of emergency reservoir pressure into the release slide valve chamber, consequently the pressure chamber, through a suitable port opened by the graduated release cap, so that if the increase of brake pipe pressure ceases, as in the event of the brake valve being moved to lap position, the inflow of emergency reservoir pressure would drive the release piston and its slide valve far enough toward application position to close the application chamber exhaust port. Under such circumstances the exhaust of application chamber pressure, and consequently brake cylinder pressure, would cease and the inflow from the emergency reservoir would be stopped until another increase of brake pipe pressure moved the release piston and graduating valve to again connect the application chamber to the atmosphere.

In this manner the release of brake cylinder pressure can be graduated, and even if the graduated release is cut in, it will not be effective if the brake valve handle is moved to release for an instant, then back to running position, wherein brake pipe pressure will be maintained.

As to recharge after an application of the brake, it will be noted that in graduated release, the pressure chamber will be recharged from the emergency reservoir at the same rate the brake pipe is being recharged from the brake valve, with the service reservoir cut off, that is, a glance at the charging valve connections will



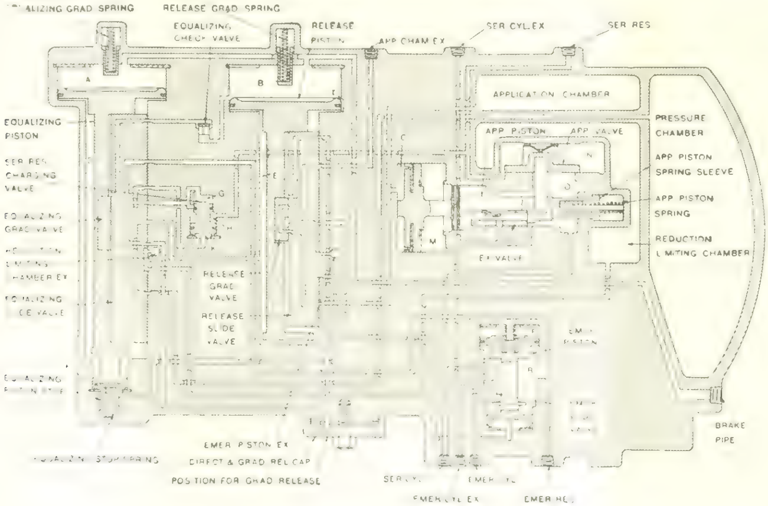
SECONDARY RELEASE.

show emergency reservoir pressure constantly on the upper or small end of the charging valve holding it down in the non-charging position which will occur upon a drop in pressure chamber pressure, and the charging valve will remain thus until the pressure chamber is again increased to within about 5 lbs. of that in the emergency reservoir and then, owing to the difference in the size of the charging valve pistons, the pressure chamber air can unseat the charging valve and charge the service reservoir from the emergency reservoir charging port.

In direct release, however, the pressure chamber is charged from the brake pipe, the emergency reservoir pressure being undisturbed and the charging valve remaining closed prevents in either case any material drain on the brake pipe during a tion to the atmosphere. At the same instant emergency reservoir pressure flows into the release slide valve chamber and to the front of the application piston, thus opening the service reservoir to the service brake cylinder in the shortest possible space of time, and as the equalizing piston and slide valve will also have moved to application position all reservoirs and brake cylinders and all chambers not open to the atmosphere will contain an equalized pressure at 86 lbs. per square inch.

This same movement of the release slide valve admits emergency reservoir pressure to the under side of the quick action closing valve and then to the quick action piston which forces the quick action valve from its seat exhausting brake pipe pressure to the atmosphere for the continuation or the initiation of quick action almost at the same instant. The discharge from the reduction limiting chamber exhaust is the momentary bleeding of the release slide valve chamber, the discharge from the emergency piston exhaust is from the equalizing stop spring chamber for the return of the equalizing piston. If the exhaust from the reduction limiting chamber continues for some little time and then ceases, it indicates that an over-reduction has been made. The blows from the application chamber exhaust and from the service cylinder exhaust will be understood as the escape of air for the release of the brake.

A continued blow from any of the ports would indicate some disorder of the control valve, and as the blows could be caused by leakage through the body gaskets, it follows that all gaskets must be



[illegible]

release of the brake; therefore, it is only necessary for the main reservoir volume on the locomotive to increase the pressure in the brake pipe alone, or in addition the relatively small pressure chamber in order [illegible]

When the release piston graduating spring is compressed and the release piston and slide valve travels its full stroke, either as a result of a sudden brake pipe reduction, an over-reduction of brake pipe pressure or from brake pipe leakage, after an application, the release slide valve will open the outside of the large end of the emergency piston to the atmosphere which permits emergency reservoir pressure on the inner side to move the piston and slide valve to admit emergency reservoir pressure directly to the emergency and service brake cylinders, and at the same [illegible] throughout the train. After the exhaust of brake pipe pressure the quick action valve will be returned to its seat by means of a spring.

The release after an emergency application is accomplished by increasing the brake pipe pressure above 86 lbs., whereupon the equalizing and release pistons will be forced to release position, and all the valves will be moved to the positions shown in release and charging position.

The foregoing along with a study of the diagrams, should be sufficiently clear to give a good general understanding of the operation of this brake; upon an application of the brake a short puff of air from the reduction limiting chamber exhaust, indicates that the equalizing piston and slide valve have moved, and during a release there are several short discharges from the exhaust ports, and they occur perfect and all nuts drawn tightly on the studs before an attempt is made to locate the source of any blow from the exhaust [illegible]

A blow from the service cylinder exhaust when the brake is released could be from a leaky application valve or from a leaky emergency slide valve. With the brake applied, it would be from a leaky exhaust valve of the application portion.

With the brake released, a blow from the emergency cylinder exhaust is caused by a leaky emergency slide valve, or a leak past the cap nut of the quick action closing valve. In service position, it would be from a leaky emergency slide valve, and in emergency position it could also be from this slide valve or from a leaky piston packing leather on the application piston or a leaky leather seal on the brake cylinder side of the application piston

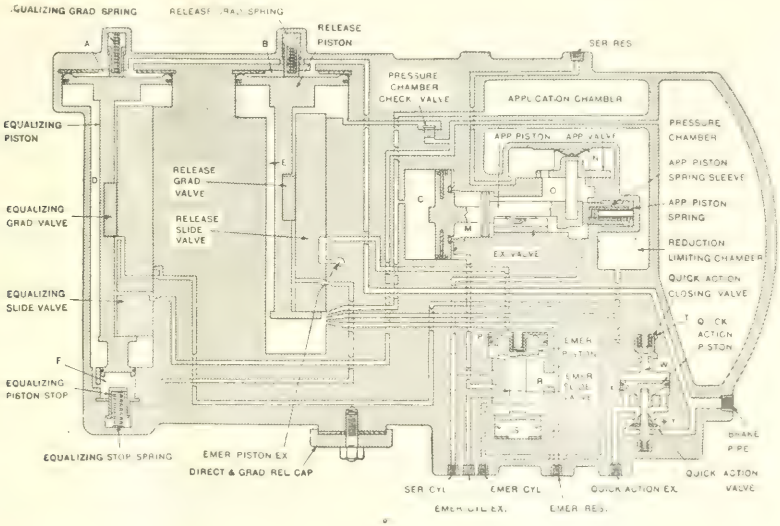
A leak from the quick action exhaust port can be handled as a leaky rubber seated valve in a triple valve; however, if a leak here occurred only after an emergency application it might be caused by a leak past the seal of the small closing valve, a heavy blow, however, would indicate that the quick action valve had stuck open.

A blow at the application chamber exhaust with the brake released, could be from either a leaky equalizing or release slide valve, or from either graduating valve. It is also possible for it to be caused by a leaky gasket under the graduated release cap. A blow after the brake is applied in service would be from a leaky release slide valve.

A leak from the emergency piston exhaust in release, is caused by a leaky release slide valve or graduating valve, by a leaky equalizing slide valve, by a leak past the seal of the equalizing piston (lower end) or by a leak past the seal of the small emergency piston. In application position a blow here is caused by a leaky release slide valve or graduating valve. If the blow occurs in emergency position only, it indicates a leak past the seal of the large emergency piston.

If a blow from the reduction limiting chamber exhaust exists in all positions it is due to a leaky equalizing slide valve or graduating valve, if it occurs only after an ordinary service reduction, it points to a leak past the cap nut of the application portion. If it occurs only when the control valve is in overreduction position, it is due to a leaky emergency reservoir check valve.

If the leak occurs in release position it is from the application cylinder cover gasket. If it is found only in emergency position it indicates a worn equalizing slide valve. The disorders of this brake are handled in about the same manner as those of a triple valve; should the brake fail to apply, the first thing to ascertain is whether the reservoirs are charged, and if apparently charged, the failure would likely be due to a disorder of the equalizing portion, possibly a stuck open equalizing check valve, again the failure to apply upon a moderate reduction may be due to a disorder of the application portion, but in all cases it is well to handle these valves, as triple valves are under similar circumstances, that is, to replace defective valves with ones known to be properly tested and in perfect condition.



EMERGENCY.

If it is necessary to cut out the brake, close the cut out cock in the brake pipe and bleed both the service and emergency reservoirs. In bleeding off a brake it must be observed that the cross heads of both brake cylinders recede to their positions when in release, or to the release end of their stroke.

Improvements on the Lehigh Valley.

It is reported that the Lehigh Valley Railroad will begin construction of its new terminals in Buffalo, N. Y., early in February. The passenger station of Indiana limestone, five stories high, will front on Main street, standing back from the street 50 feet, occupying the block between Main and Washington and Scott and Quay streets. On the east side of Washington street the plans call for another building for the baggage department and train shed, the passenger station and the train shed to be connected by a tunnel under Washington street. There are to be 10 tracks for passenger trains and the station will be used by the Erie Railroad, Wabash Railroad and New York, Chicago & St. Louis R. R., in addition to the Lehigh Valley. The total cost is estimated at $5,000,000. The arrangement by which the Erie is to enter the new station will enable that road to utilize its present passenger terminal at Michigan and Exchange streets for local freight purposes.

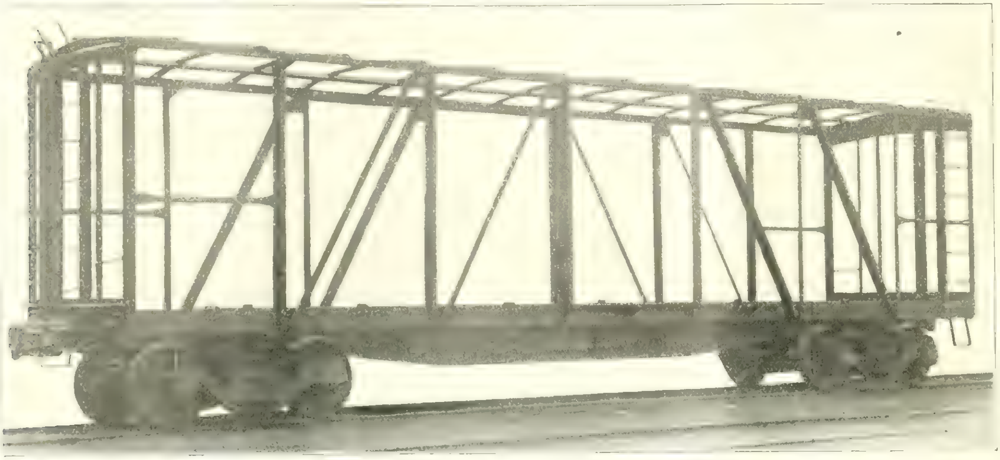
Railways in Sweden.

It appears from despatches received last month that the railroad circling the gulf of Bothnia, the northern extension of the Baltic sea, virtually is completed. There was a gap of ten miles over which passengers from Stockholm to Petrograd had to drive. Now this distance has been reduced to half a mile. The Russian line runs to a point opposite the Swedish station at Karungi. Here passengers leave the train and go half a mile over the frozen river Tornea, instead of the previous journey between the town of Tornea and Haparanda, a distance of ten miles. The new arrangement is working well. Between 500 and 800 passengers make the trip daily, the uncertainties of steamship travel between the Swedish coast and Russian ports near Petrograd having influenced many travelers to select the land route. Heavy freight also is being moved overland with little delay.

New Box Car for the Illinois Central Railroad

[illegible] in recent years have not been so much in the matter of details of construction as in the marked improvement in materials which [illegible] perfection hitherto unattainable.

The box car illustrated is one of a lot of 1,500 recently received by the Illinois Central Railroad from the works of the Western Steel Car & Foundry Company at [illegible], Ill. The car is 80,000 pounds capacity, and as will be noted from the illustrations, has the latest form of steel superstructure, consisting of 3 ins. 6.7 pounds Zees for side posts and braces, [illegible] posts, and 4 x 4 x 5/16 in. angles for corner posts. There are also 13¼ ins. pressed steel carlines.



[illegible] CAR SHOWING STEEL FRAMING FOR THE ILLINOIS CENTRAL RAILROAD.

The steel underframe is made up of two center sills of 5/16 in. plates 24 ins. deep at center and 10 15/16 ins. deep over bolsters. These center sills extend 18⅝ ins. beyond bolsters, and are tied together and reinforced at top with 19 x 5/16 in. cover plate and 3½ x 3½ x 5/16 in. angles, and at bottom with 5 x 4 x ⅝ in. angles. Draft sills are ½ in. pressed steel, end sills 10 ins., channel 15 pounds per foot, reinforced at top with ¼ in. plate and a coupler opening with cast steel striking plate, and the side sills are 9 ins. channels 13¼ pounds per foot. The body bolsters are built integral with underframe, and consist of 4 diaphragms of ¼ in. pressed steel, one malleable iron center brace and [illegible] top and bottom with 16 x ⅜ in. plates. There are two cross bearers made of ¼ in. pressed diaphragms 14¼ ins. deep at center sills and 4⅝ ins. deep at side sills, reinforced at top with 8 x ⅜ in. plate and 3 x 2½ x ¼ in. angles, and at bottom with 3 x 2½ x 5/16 in. angles and ¼ in. pressed brace. There are 4 diagonal braces made of 4 x 2½ x ⅜ in. to 7/16 in. rolled Tees extending between bolsters and end sills. [illegible] diaphragms made [illegible] 3/16

[illegible] CAR FOR THE ILLINOIS CENTRAL RAILROAD

x 4 x 3 1/16 ins. by 1/4 in. Zees on each side of car between bolsters. Between the center sills there are 4 diaphragms made of 1/4 in. pressed steel.

There are four longitudinal floor stringers per car, the intermediate stringers being 2 11/16 x 3 x 2 11/16 x 1/4 in. Z bars, and the center stringers 3⅜ x 3½ ins. yellow pine. The flooring is yellow pine 1¾ in. thick, 5¼ ins. or 7¼ ins. face width, matching M. C. B. shiplapped. The lining is yellow pine, tongued and grooved 1½ ins. thick, 5¼ ins. or 5⅛ ins. face width. The side plates consist of 3 1/16 x 4 x 3/16 x ¼ in. Zees, and the end plates of 3/16 in. open-hearth steel. There are two purlines per car made of 2 x 6 ins. yellow pine; the ridge pole is yellow pine 1⅞ x 6 ins.; the running board is yellow pine, 24 ins. wide, 1⅛ ins. thick.

The car is equipped with the following specialties:

Body center plates, drop forged. Air brakes, New York, schedule F-10-CK, modified. Couplers, Sharon, cast steel, 5 x 7 ins. Coupler operating device, Carmer. Draft rigging, Miner tandem, D-963. Roof, Hutchins all steel. Truck frames, Scullin & Gallagher pedestal cast steel with Barber roller device. Truck bolsters, cast steel. Brake beams, Ajax No. 104. Journal boxes, malleable iron. Wheels, grey iron, 675 pounds.

The use of steel framing and inside lining in box car construction reduces cost of repairs, avoids grain pockets and therefore the loosening of sides by the swelling of grain in such pockets. The steel frame prevents "racking," requires no tightening of rods and bolts and will unquestionably outlast the old wooden frame construction. The steel frame car is therefore rapidly coming into general use with the leading railroads of this country.

The principal dimensions are as follows: Length inside, 40 ft. 6 ins.; width inside, 8 ft. 6⅛ ins.; height from floor to carlines, 8 ft. 3⅞ ins.; width of side door openings, 6 ft.; height of side door openings, 7 ft. 10⅜ ins.; length over end sills, 41 ft. 10¼ ins.; width over eaves, 8 ft. 11½ ins.; height from rail to top of floor, 3 ft. 11 ins.; height from rail to top of running boards, 13 ft. 2⅝ ins.

Coke as Locomotive Fuel.

It is curious to find the using of a device entirely successful at one time and a lamentable failure at another. When that ornate assemblage, the British parliament, first gave railways permision to move trains through the country, very strict regulations were insisted on against causing smoke. Nearly every factory chimney in the British Isles was pouring out black smoke without restraint, but for a locomotive engine to emit smoke was something not to be endured. Such a thing would poison the atmosphere, taint God's scenery with blackness and even prevent cows from yielding their natural flow of milk. The certain preventative was for all locomotives to burn coke, a material that had been purified from its smoke-creating properties.

Accordingly all British railways used coke to generate steam that enabled locomotive engines to haul trains. This lasted for the first thirty years of British railway operation. Towards the end of that time questions of economy became to raise their heads among railway managers, and the cost of fuel loomed up as a ruinous item. Coke generated steam satisfactorily, but its use cost double the cost of steam making by ordinary coal. Inventors went to work and produced furnaces capable of smokeless firing with bituminous coal, and the question of fuel economy was solved.

To those who have been familiar with the use of coke as a locomotive fuel in Europe, some remarks made by Mr. D. F. Crawford at last master mechanics' convention are curious. Mr. Crawford remarked: "A few weeks ago there was introduced into the city council an ordinance which compels the use of coke on switch engines, not using coke on switch engines, but endeavoring to use it, and we do not want to endeavor again, either from a financial or an efficiency standpoint.

Transmutation of Metals.

Sir William Ramsay has been reporting to the Chemical Society in London the results of some additional experiments which he recently made, but only the purport of his report has as yet been published. There is, however, enough to enable us to note some resemblances between his later work and that performed two or three years ago.

Mendelief made a discovery of fundamental importance in chemistry, namely, that between the atomic weights of elements having similar traits there exists a certain mathematical relationship. In accordance with the accepted system of classification copper, potassium and lithium, etc., belong to one group, and thorium, zirconium and carbon belong to another. Sir William believed that under the influence of radium microscopic quantities of copper were converted into lithium and potassium. Now he announces that he has obtained carbon from thorium and zirconium. In both cases the product was a lighter element than the raw material. The atomic weight of copper is 68, and that of lithium 7, while that of thorium is 2.32 and that of carbon 11. Bismuth, however, is heavier than carbon, and it belongs to an entirely different group.

Many chemists of large experience and high standing do not put the same interpretation on Sir William's work that he does, but before pronouncing a verdict are anxiously awaiting the publication of his report. It is said that the quantity of material apparently transformed in Sir William's experiments is so small that it cannot be weighed, and that its nature can only be determined by spectroscopic tests. It is said also that Mme. Curie tried to duplicate his work with copper last year, but was unable to convince herself that Sir William's faith was well grounded. It may be noted that a substance more costly than diamonds is essential to the changes which Sir William thinks he has wrought, and that the price of radium at present utterly precludes its use in the manufacture of other substances.

Between Edinburgh and London.

The exact period of the establishment of stage coaches between Edinburgh and London cannot be ascertained. In the end of the seventeenth century it was necessary for persons desirous of making the journey to club for the use of a conveyance. His Majesty's physician, Sir Robert Sibbald, relates that this year "he was forced to come by sea, for he could not ride by reason that the fluxion had fallen upon his arms, and he could not get companie to come on a coach." It was usual for people going to London long after this period to make their settlement, take farewell of their friends, and be prayed for in churches as taking a long and dangerous journey. In 1700 it required one hundred and thirty-one hours to perform the journey from Edinburgh to London, some 500 miles.

In Favor of Porridge.

A medical inspector of schools recently bemoaned the decline in the consumption of porridge, and the *Medical Press* thinks his complaint has its moral for all parts of the British Isles. "Nothing," it says, "is more governed by fashion and custom than the choice of food. Were porridge eating to come into fashion there would be no need to preach its virtues to any class of society; it would, in a trice, become popular as tea or tobacco from the humble cottage to the lordly palace. So far as eugenics are concerned the general introduction of porridge—one of the most valuable of foodstuffs—would in a single generation do more to improve our race than a hundred years of popular agitation." Why not begin, asks our contemporary, with the school-children?

St. Louis Railway Club.

At the regular monthly meeting of the St. Louis Railway Club, to be held on Friday evening, February 12, R. M. Ostermann, Chicago representative of the Locomotive Superheater Co., will read a paper defining the relation existing between superheater practice and reduced costs of locomotive operation.

Electrical Department

Inexpensive Excavation by Means of an Electrically Driven Thew Shovel.

[illegible] company, in [illegible] considerable amount of excavation, and by using an electrically operated auto- [illegible] was done the most economically.

The shovel, shown by illustration, is of the horizontal crowding motion type, and has several other features of interest. [illegible] with a [illegible] clearance height over the house of 12 ft. 2 ins. It is mounted on regular car wheels, on which it travels on the car tracks, and in addition is equipped with a set of auxiliary traction wheels, 33 ins. in diameter, and

[illegible] DRIVEN THEW SHOVEL

15 in. tread, which permits it [illegible] ground, pavement, or wherever it is desired to take it.

The horizontal dipper crowding motion utilized is said to be particularly adapted to the application of electric drive because of the ease of control and power demands. In excavating material with a shovel, it is necessary first to crowd the dipper forward into the material, then [illegible] material. In this case, the first motion is made horizontally, being obtained a [illegible]

The dipper is suspended by [illegible] able arm, hinged to a carriage [illegible] trackway. This enables the [illegible] the point of rotation for dipper, so that the hoisting force is at all times exerted in the most effective manner, while the crowding force is applied horizontally. The combination of the horizontal trackway and the boom channels results in a structure braced and reinforced to withstand the severe strains which the boom is called upon to endure.

The trolley motion is controlled by a lever. This lever is further connected to a trip rod which is operated automatically when the trolley reaches the limit of its motion in either direction.

The crowding motion enables this type of shovel to be advantageously employed for very shallow excavating operations.

The shovel is equipped with a Westinghouse 20 [illegible] direct current motor, and a control equipment for starting and reversing. The motor is run at constant speed and the various motions are obtained through [illegible]

The current is usually admitted to the shovel through a flexible insulated cable connected to a switch on the truck frame and transmitted through copper rings to brushes suspended from the swinging turntable.

The use of one motor appears to be a particularly desirable feature, for reducing the initial cost, and affording greater flexibility of action in the frequent reversals of the various operating motions; it also means the operation of three levers instead of three separate controllers, and a gain in time over starting and stopping three separate motors. It is distinctly a one-man machine.

Splicing of Electric Cables.

Too much consideration can hardly be given to the splicing of joints made in electric circuits and especially in circuits carrying heavy currents. If the joints are not made properly reliability and stability of an electric system will not be obtained, no matter what the kind and size of the cable used. A poor joint means excessive heating, and if this heating continues a burnout may be the result. Moreover, after a satisfactory joint has been made, as far as the splicing and soldering of the copper strands are concerned, it is equally important that sufficient insulation be placed over this joint or failure may occur, due to the actual electric break-down, i. e., the voltage of the electric power is too great or, in other words, the right kind of insulation of the proper amounts has not been used to prevent the electric power passing through the insulation to ground. The grade of insulation and the amount to be used is a very important factor, especially in high voltage work.

Cost of Electric Locomotives in Heavy Trunk Line Service.

A New Haven Railroad official is quoted as saying: "Upkeep of electric engines is on the order of 5 cents to 7 cents per locomotive mile per 100 tons of weight. Steam-locomotive maintenance runs anywhere from 8 cents to 25 cents, depending upon nature of the coal and water used—an average figure of 11 cents would not be bad. With regard to pounds of coal burned for electric-engine versus steam-engine haul, a pound of coal burned under the boilers of a central electric station for such traffic will develop twice the drawbar pull that would be developed if the same pound of coal was burned in the firebox of the steam locomotive."

The Thermal Telephone.

Mr. de Lange recently described in a paper before the Royal Society, London, his new thermal telephone or thermo- [illegible]

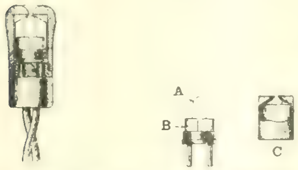
In the ordinary telephone receiver there [illegible] diaphragm which is vibrated by change

in value of an electro-magnet located just back of or underneath the diaphragm. A person talking into the transmitter at the other end of the wire causes varying currents to flow over the wires and a varying current in the coil around the electro-magnet of the receiver. This change in magnetic strength causes the diaphragm to vibrate in unison and the sound is reproduced.

Although telephone currents are exceedingly small in value compared with power currents, still they are of definite value and it would be of great advantage if the amount of current required to operate the magnetic receiver could be reduced, for by reduction of current larger transmission of messages could be obtained.

The idea of using the electric current set up by the transmitter of the telephone to heat up a small wire, the temperature of this wire varying with the pulsating current was first thought of about 35 years ago. Platinum is very sensitive to heat and the variations in the lengths of a platinum wire due to changes in current and hence changes in temperatures were transmitted to a diaphragm.

In the de Lange thermophone there is



DETAILS OF THE THERMAL TELEPHONE

no diaphragm used; the wire speaks without a diaphragm. While in the air the sound is very weak, but if placed in a cover in one or several openings the sound becomes clear and distinct. The construction is as shown in the figure. A small wire, A, of .002 mm., so small that it is practically invisible, which has had a special treatment, is attached to two small brass half circular blocks, B. The pins from these blocks fit into a small socket as a holder. A metal cap, C, having a very small opening at the top, is slipped over the terminal block, B, and forms a resonator. The illustration is full size and is for insertion in the ear. If a larger receiver is desired, several of the small wires can be arranged in parallel and a receiver is obtained which can be placed against the ear.

The theory of the instrument is that the decrease and increase of heat in the platinum wire occurs with the variations of current set up by talking into the transmitter at the other end of the line. The air surrounding the platinum wire is thereby immediately heated or cooled, and if that air is retained within a small space, the expansions and reactions are noticed as sounds.

Apparatus for Signaling Under Water.

Everything is being done, new inventions are being made and experiments being tried to make travel at sea as safe as possible.

One of the latest pieces of apparatus to be used in this connection is the electrically operated oscillator made by the Submarine Signal Company, of Boston, Mass. This oscillator is for sounding, determining the proximity of icebergs, and sending and receiving telephonic and telegraphic messages under water. By using one of these devices for sending and a microphone for receiving it is declared that a submarine telegraphic message has been sent 31 miles. If an oscillator is also employed for receiving, it becomes possible to signal over longer distances. Claims have also been made that with six dry cells and an ordinary transmitter in series with the oscillator conversation has been carried on between stations 400 yds. apart.

The device, which is about 20.5 ins. in diameter by 15 ins. thick and weighs 850 lbs., is very rugged and requires hardly any attention. It consists of a heavy diaphragm 1 in. thick, which is made to vibrate by being attached to a copper cylinder sliding in a gap, across which is induced a magnetic flux or field. This flux exerts a certain force in the cylinder and the heavy diaphragm is set up in vibration. The vibration is imparted to the water, which is the transmitting medium, by the diaphragm attached to the cylinder. While this apparatus is built to consume 35 kw., it can be operated by an ordinary telegraph key without excessive sparking, as the circuit is practiclly non-inductive. For determining the depth of water and the distance to a large body like an iceberg time is counted from the sending of a signal until an echo is heard. The distance is then a function of the time.

Signal Lighting Transformers.

A new line of miniature air cooled transformers, known as type M, has been developed by the General Electrical Company for railway signal lighting. These transformers are distinctive in application and design. They are enclosed in a neat and compact case, either for indoor use or in a weatherproof form for outdoor use.

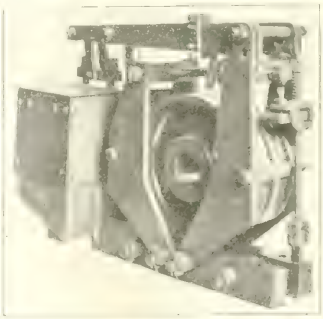
The transformers are fitted with standard R. S. A. terminals, as shown by the accompanying illustrations, and are furnished in sizes for 25 to 125 watts, 25 and 60 cycles.

A lamp of from 2½ to 5 watts is generally considered sufficient for signal illumination; consequently, a transformer of this kind with 6 to 12 volts, 2½ to 5 watts, high efficiency Mazda lamps makes a very satisfactory, as well as economical system of lighting.

An Automatic Electrically-Operated Solenoid Brake.

In connection with hoists, cranes, lift bridges, etc., it is essential that a brake be available to secure positive operation. With operation of these devices by electricity it is possible to obtain a very positive and efficient brake and one which is automatic. Moreover it is so arranged that electric current must be available to have the brake in the released position, and with this arrangement, if the power should fail, or the leads become disconnected, or anything occurs to disconnect the electric current from the device, the brake is applied instantaneously thus possibly avoiding a serious accident.

These brakes may be mounted on the floor, or attached to the motor. The illustration shows a pulley wheel, which would be fastened to the motor shaft, between the two brake shoes. These shoes are supported each on a plate yoke, which are hinged at the lower end, and act as levers for applying the necessary



ELECTRICALLY OPERATED SOLENOID BRAKE.

pressure to the shoes to give effective braking.

At the long end of the horizontal lever at the top, is attached an electric magnet or solenoid, enclosed in the box. With no electric power connected to the solenoid, the weight of the plunger is transmitted through the horizontal levers to the free or top ends of the yokes and to the brake-shoes, so that the brakes are applied. The various levers are so proportioned that the weight of the plunger is multiplied and a powerful brake is obtained. When electric current is connected to the solenoid, or in other words when it is energized, the plunger is raised, and the brake is released. It is readily seen that the normal position of the plunger is down with brakes on and that the brake is held in the release position by the electric current passing through the solenoid so that any disruption of the electric power causes the brakes to be applied immediately.

Pooling Locomotives

Interesting Discussion at the Convention of the Traveling Engineers' Association

At the last convention of the Traveling Engineers' Association there were many discussions that imparted new light to subjects nearly all railway men are interested in. The following comments were made on the subject of pooling locomotives:

Mr. [illegible] Shaw, International and Great Northern: I believe the title of this paper is understood by us all as "Operation of All Locomotives with a View of Obtaining Maximum Efficiency at Lowest Cost." The statement has been made by some of the members present that we should not spend any time discussing the manner in which the engine is worked and I believe that they are wrong. The first cost in the operation of a locomotive, or the most important one, is the fuel. The amount of fuel that is used is determined by the amount of steam that is consumed. The amount of steam consumed is also determined by the manner in which the engineer works the engine. As far as the wide open throttle is concerned, I will say that I agree with the gentlemen who are in favor of the wide open throttle. By the wide open throttle I do not mean that we have to pull the throttle back against the lubricator and leave it there, but we are to have the throttle valve open wide enough to admit all the steam into the steam chest the port opening will require. It seems that if we are to get the right cut-off for the engine we have to leave it entirely to the engineer. We probably all know it to be a fact that some men are what you call engineers, and they can sit up on the engine, drop the lever down and hook her up, and seem to do it mechanically; they may be thinking about something else at the time, but they are always able to strike that happy medium, that is, a point between too high and too low. There is always a nice intermission between the exhausts, and the engine seems to have an even and regular stride much the same as a race horse would have, goes on and does the work. While the engineer who is not able to do that is the man who has been brought up, not overstocked with [illegible] he is always in doubt as to whether he can pull them up or not. In other words, he begins dropping the lever down until he gets it in the dividend notch and works the engine up the hill in that way. That is undoubtedly money wasted. If we are [illegible] operate the engine economically we must [illegible] an engineer as anybody else and that as long as he is on the engine we know that [illegible] which I think most of the members present will take issue with me. It is this: In the economical operation of the locomotive I am very strong for the pooled engine. I know many of you think you ought to have regular engines, but the fuel consumed by the locomotives is the item that counts, and I think the mechanical department of each railroad should put the engine in first-class condition, so that it can go from one terminal to the other regardless of who runs it as long as he is an engineer. Keep all the packing and steam pipes tight, and a man can get on and run to the other end of the railroad. If we have the regular engine when he gets to the other end of the road, the Federal Compulsory Rest Law puts him to bed at least 8½ hours. We have to maintain a fire in the engine all the time. If each one of you would think of the different terminals on the lines with which you are connected right now and try to figure out how many engines are standing in these terminals with fires in them, each one burning up money, how much do you suppose it is? If you could run the engine in, clean the fire if it is a coal burner, or turn her around if it is an oil burner, how much money would be saved?

It is claimed that the regular crew on a locomotive keeps the engine in better condition. I do not believe it. We have some of them that will not do a thing. I see some fellows that take an interest in the engine they are running, and they do the same amount of work on a pooled engine that they would on a regular engine. Therefore, I am strongly in favor of the pooled engine as far as economical operation is concerned, especially with regard to fuel.

Mr. L. R. Pyle (M. St. P. & S. S. M. Ry.): The committee evidently did not intend to take up the subject of regular engines, but as long as the gentleman has spoken in favor of the pooled engine, I would like to say that at one time on the Soo Line we had pooled engines, but have had engines assigned to regular crews for a number of years. Just lately we have gone into the regular engine system more than ever, and for quite a number of reasons, I must disagree with the gentleman on the pooled engine question.

There is a statement in the report which says that a poor machine carefully handled will do better work than a good machine [illegible] assigned to one engine will always do better work. Some time ago we gave a man a regular engine which was a close candidate for the back shop. He had been running a pooled engine. I would like to say here that we do all the work that is reported on pooled engines. We told this engineer that he could have the engine as long as he could keep her out of the shop. In about a month after we assigned this crew to the engine mentioned, we extended the mileage at least fifteen thousand miles. I cannot say that engine will make the mileage, but she was in good enough condition to warrant the mileage being extended that much. The roundhouse force did not do any more on that engine than they had been doing, but the engineer was anxious to have an engine that he knew he was to have every trip, so he did a lot of work on the engine himself. This man on the regular engine is doing the same work with an engine nearly worn out, as the other men are doing on new engines, and will continue to do so as long as the engine is out of the shop.

We want men to use as little oil as possible and still lubricate the engine. With a pooled engine, your engineer does not know how the engine is going to lubricate, or run, until he has made quite a few miles. The regular man knows just what his engine will do at the start, and will so use less oil and will still lubricate the engine.

The regular man knows how the wedges and rods are, and just how she will run if he wants to make up time. He knows the condition of the cylinder packing so that he may report it renewed if necessary. One could talk for an indefinite length of time on the advantages of a regular engine, but I will try and be brief. In regard to running repairs, if you give a man a regular engine he will do much work for you that you will pay a machinist thirty-five or forty cents an hour for, and he will do it better than any machinist because he knows just what is necessary in the way of setting up wedges and keying rods. When a machinist sets up wedges in the house, the boxes are cold and oftentimes the engine does not stand right, but he spends the time on them if they are reported. Many times the engineer has to stop and pull the wedges down after they have been set up by a machinist. This can all be avoided on regular engines. Your engineers will do this work for you for nothing for the privilege of having an engine that they know they will use tomorrow, and the next day, and the day after that.

It is not a question in this paper whether it is better for traffic conditions or not. On some roads you cannot have regular engines, you have not enough of them, but where you have engines enough to give each man a regular engine, you will get better work on the road and many little jobs on the engine which you will not have to pay for.

The matter of engine inspection was brought up. When you have assigned crews on regular engines you have the

best engine inspector which you can possibly get. The regular engineer walks around the engine several times each trip and on arriving at a terminal, he will know everything wrong with the engine, and if you encourage him to report the work by doing it after it is reported, you will maintain the locomotive in first-class condition as long as it is out of the shop. Many of the small jobs he will do for himself.

When you give a man a regular engine out of the shop you can say to him, "This is your engine and you will be held responsible for the condition of the machinery at all times." You can do this because when the traveling engineer rides the engine and finds it pounding badly or cylinder packing blowing, or any other defect, he can place the responsibility, as only one man has been running the engine.

On the other hand, let the traveling engineer get on a pooled engine and finds the boxes pounding or cylinder packing blowing, how is he to know who is responsible? He will say to the engineer, "Why do you run an engine in this condition?" The engineer will answer, "This is the condition that the engine was in when leaving the terminal this morning. I have had no time as yet to report any work." Where you have five engines with ten men running them it is impossible to place the responsibility on any one man.

We all know that with the mechanical department crowding the roundhouse foreman and trying in every way possible to reduce running repairs, many times work is slighted on pooled engines which would not be on the regular engines. The condition of our machinery on the Soo Line shows that the regular engine is the cheapest engine to maintain.

My claim against the regular crewed engine is that every engine stands around with a fire in it while the crew is at home asleep. You can reduce the number of engines if pooled. For instance: You have thirty engines on the division with regular crews. If you run them in and double them out and run to the other end and double them out, will you need thirty engines? You can do it with twenty-four engines. Can you not keep up twenty-four engines cheaper than thirty? You figure that you get good service out on the road and the crew helps you to take care of the engine, but can you not do a whole lot of work on it for the fuel you burn up in the terminal while the men are asleep? Cannot you men at the head of the mechanical department fix the engines so that anybody can run them?

Mr. B. J. Feeney (I. C.): Hearing this discussion on regular and pooled engines, I wish to say that I have visited a great many railroads that have regular engines, and from the expressions made by the mechanical men in charge and the enginemen who run the engines it is very clear to me that the regular engines are an economical proposition.

The president of the Illinois Central Railroad has made some investigations with some of the roads that had regular engines, and I want to say to you gentlemen that if you would only go to the Illinois Central Railroad you would find some figures that are amazing and surprising to all, as to the difference between pooled and regular engines.

In the years when we had pooled engines, it was impossible for any man to trace who was responsible for any neglect of the locomotive. You know yourself when you met the engineer and asked him the question, he would say, "Bill So-and-so had this engine yesterday part of the time." You found him and he would tell you something about the roundhouse foreman. You went to him, but he was the wrong foreman; you had to see the right man. You could never determine who was responsible for neglect of the engine.

In the days of pooled engines the engine failures were numerous. I think a great many of you had the same experience. Today we have locomotives on our division that the men say will run from overhauling to overhauling without an engine failure. What we call an engine failure on the Illinois Central is anything that fails to maintain schedule time, which is pretty close. We are running as large a single engine as are run by any of you gentlemen. The fireman will say: "I can fire this engine from so-and-so to so-and-so with so many scoops of coal." There is a rivalry between them as to saving coal, oil and supplies.

I am surprised to see this question come up again, but I like to hear a [illegible] press his opinion as to what he thinks. I think if the gentleman will go around to some of the railroads that have changed back from pooled to regular engines he will immediately see how it is.

The idea of taking a locomotive and keeping it fired up until the regular man goes out again is wrong. Why should we do that? I say the right way to do is to knock the fire out, set the engine on the side track, and fire up two hours before you want it. It is a waste of fuel to keep up a fire until a man is ready to go out.

The only thing in favor of pooled engines is that some transportation man will have a train in the yard and there will be no engine ready for an hour or two, and he wants the engines pooled. I think that was the cause of bringing the pool about in this country.

Mr. E. J. Frazer (Q. & C.): We run regular engines in freight and local and [illegible] miles and regularly assigned freight engines from twelve to fifteen months; our engines in extra service run about nine months. A banked fire with a board over the stack with a four-inch hole will stand for fifteen hours; an engine with a solid board over the stack will stand fifteen to twenty-four hours and hold steam to renew fire without fire in the fire-box.

Increase of Safety on the Lehigh Valley.

We are always gratified when we find that a railroad company introduces of its own volition a safety appliance device by one of its own employes. At the suggestion of Mr. C. F. Rudolph, a telegraph operator belonging to the Lehigh Valley Railroad, the company has issued the following order:

"When freight trains are pulling out of sidings, or away from inspection points, or water stations where a stop has been made to take water, the engineer will move the train not to exceed six or eight miles an hour to permit a member of the crew to make a running inspection of the entire train.

"At such points, one or more members of the train crew must be at the head end of the train before it starts and inspect the train as it passes, watching closely for bent axles, broken flanges, brake riggings down, defective brake riggings, defective arch bars, defective drawheads, wheels sliding, brakes sticking, loose wheels, hand brakes applied, car doors loose, or any other defects that can be detected."

Doubtless this precautionary measure will be taken up by other railroads, as railway men are quick to adopt whatever is good, no matter what source it comes from.

Master Mechanics' and Master Car Builders' Conventions.

The annual conventions of the American Railway Master Mechanics' and the Master Car Builders' Association in 1915, will be held, as in previous years, at Atlantic City, N. J. The Master Mechanics' convention will be held on Wednesday, Thursday and Friday, June 9, 10 and 11, and the Master Car Builders' convention on Monday, Tuesday and Wednesday, June 14, 15 and 16, 1915. The meetings, as usual, will be held in the Greek Temple, on the ocean end of the Million-Dollar pier, and no better location could be found in America or anywhere else.

Headquarters for both conventions will be at the Marlborough-Blenheim hotel, at which the president, executive committee and secretary will have offices, and accommodations will be furnished for meetings of the various committees. The usual instructions regarding hotel accommodations and registration are given out. Persons desiring further information should address the secretary, Jos. W. Taylor, 1112 Karpen building, Chicago, Ill.

Items of Personal Interest

Mr. G. A. Hillman has been appointed erecting shop foreman of the Erie with office at Galion, Ohio.

Mr. O. E. Linn has been appointed road foreman of engines of the Vandalia, with office at Decatur, Ill.

Mr. Clyde Ribley has been appointed night roundhouse foreman of the Santa [illegible], Cal.

Mr. Harry M. Muchmore has been appointed division foreman of the Santa Fe, with office at Deming, N. M.

Mr. R. Gardner has been appointed locomotive foreman of the Grand Trunk, with office at Island Pond, Vt.

Mr. A. W. Johnson has been appointed roundhouse foreman of the Santa Fe, with office at Richmond, Cal.

Mr. Joseph Keller has been appointed general fuel inspector of the Lehigh Valley, with office at South Bethlehem, Pa.

Mr. E. Wanamaker has been appointed electrical engineer of the Rock Island Lines, with office at Chicago, Ill.

Mr. F. N. Norman has been appointer master mechanic of the Marshall & East Texas, with office at Marshall, Tex.

Mr. E. H. McCann has been appointed master mechanic of the San Antonio, Uvalde & Gulf, with office at Pleasanton, Tex.

Mr. Frank Aitken has been appointed master mechanic of the Pere Marquette, with office at Grand Rapids, Mich.

Mr. J. J. Stahl has been appointed [illegible] Great [illegible] N. D.

Mr. H. H. Jones has been appointed master mechanic of the Colorado & Wyoming, with office at Segundo, [illegible]

[illegible] locomotive foreman of the Chicago [illegible] Minn.

[illegible] ed master mechanic of the Louisville & Nashville, with office at Nashville, Tenn.

Mr. N. H. Hauser has been appointed mechanical engineer of the Chicago & Eastern Illinois, with office at Danville, Ill.

[illegible] general foreman of the Rock Island Lines with office at Eldon, Mo., succeeding Mr. W. H. Burleigh.

Mr. J. E. Gogle has been appointed master mechanic of the Fourche River Valley & Indian territory, with office at Bigelow, Ark.

Mr. J. E. Giles has been appointed foreman of locomotive repairs of the Pacific Great Eastern, with office at Squamish, B. C.

Mr. E. A. Everhart has been appointed master mechanic of the Charles City Western, with office at Charles City, Iowa.

Mr. S. E. Mueller has been appointed general foreman of the Rock Island Lines, with office at Rock Island, Ill., succeeding Mr. [illegible]

Mr. W. F. Moran has been appointed roundhouse foreman of the Rock Island Lines, with office at Shawnee, Okla., succeeding Mr. A. Hamilton.

Mr. B. F. Beckman has been appointed [illegible] ern and St. Louis, El Reno & Western, with office at Fort Smith, Ark.

[illegible] master mechanic of the Apalachicola Northern, with office at Port St. Joe, Fla., [illegible]

Mr. James G. Donovan has been appointed division engineer on the Mahanoy and Hazleton division of the [illegible] Pa.

Mr. Irwin A. Seiders, formerly road foreman of engines of the Philadelphia & Reading, at Reading, Pa., has been appointed fuel inspector on the same road.

Mr. J. A. Burton has been appointed night roundhouse foreman of the Chicago Great Western, with office at Des Moines, Ia., succeeding Mr. George Bailey.

Mr. N. M. Barker has been appointed master mechanic of the Copper Range, with office at Houghton, Mich., in place of Mr. J. A. Berg, assigned to other duties.

Mr W. Walthaner has been appointed master mechanic of the Baltimore & Ohio, with office at Newark, Ohio, succeeding Mr. O. J. Kelley, assigned to other duties.

Mr. F. K. Moses, formerly foreman [illegible] rett, Ind., has been appointed master mechanic on the same road, with office [illegible]

[illegible] house foreman of the Canadian Pacific at Vancouver, B. C., has been appointed night roundhouse foreman, with office at Calgany, Alt.

Mr. D. E. Smith, formerly locomotive foreman of the Grand Trunk at Biggar, Sask., has been appointed to a similar position on the same road, with office at Regina, Sask.

Mr. Peter E. Talty has been appointed chief train dispatcher, and Mr. Frank E. Thomson, assistant chief train dispatcher on the Minnesota division of the Illinois Central, with offices at Dubuque, Ia.

Mr. Norman Bell has been appointed master mechanic of the Minnesota and Iowa divisions of the Illinois Central, with office at Waterloo, Iowa, in place of Mr. Frank W. Taylor, resigned.

Mr. P. E. Crawley has been appointed vice-president of the operating department, in charge of transportation and equipment maintenance on the New York Central, with headquarters at New York.

Mr. H. Cramer, formerly road foreman of engines of the Seaboard Air Line at Savannah, Ga., has been appointed supervisor of locomotive operation of the lines south of Columbia, with office at Jacksonville, Fla.

Mr. L. P. Rossiter has been appointed division engineer on the Lehigh Valley, with office at Buffalo, N. Y., succeeding Mr. E. T. Reisler, who has been transferred to a similar position, with office at Auburn, N. Y.

Mr. J. W. Tripp has been appointed general manager of the lines from New York to Buffalo on the New York Central, with headquarters at Albany, N. Y. The position of assistant general manager has been abolished.

Mr. W. H. Arkenburgh, publicity manager of the Union Switch & Signal Company, has joined the sales department of the National Carbon Company, Cleveland, O., and will have charge of railway and signal work in Canadian territory.

Mr. Frank W. Taylor, formerly master mechanic of the Illinois Central, at Waterloo, Iowa, has been appointed superintendent of motive power of the International & Great Northern, with headquarters at Palestine, Tex.

Mr. J. J. Bernet has been appointed resident vice-president at Chicago, Ill., of the New York Central Lines. He will act as general representative of the company in that territory and perform such other duties as may be assigned to him.

Mr. A. E. Hamlet, formerly road fore-

man of engines of the North Carolina division of the Seaboard Air Line, at Hamlet, N. C., has been transferred to the Alabama division to a similar position, with office at Americus, Ga.

Mr. J. K. Brassill, formerly general master mechanic of the Northwestern Pacific, at Tiburon, Cal., has been appointed superintendent of motive power and marine equipment of the Northwestern Pacific Lines, with offices at Tiburon.

Mr. C. T. Sherry has been appointed traveling engineer on the Cleveland, Cincinnati, Chicago & St. Louis, with jurisdiction over all divisions. Mr. Sherry claims that his promotion is largely owing to his perusal and study for many years of the pages of RAILWAY AND LOCOMOTIVE ENGINEERING.

Mr. H. H. Seabrook, formerly district manager of the Westinghouse Electric & Manufacturing Company in Baltimore, has been appointed district manager of the company at Philadelphia, succeeding Mr. J. J. Gibson, who has become manager of the tool and supply department at East Pittsburgh.

Mr. D. J. Madden has been appointed supervisor of locomotive operation of the Erie Railroad, Mahoning division, with headquarters at Cleveland, Ohio, in place of Mr. J. J. McNeill, transferred to road foreman of engines at Cleveland, succeeding Mr. P. K. Sullivan, assigned to other duties.

Mr. D. R. MacBain, superintendent of motion power of the Lake Shore & Michigan Southern, with office at Cleveland, Ohio., and Mr. G. C. Cleveland, chief engineer of the same road, have had their jurisdiction extended over the Illinois division of the New York Central, formerly the Chicago, Indiana & Southern.

Mr. E. E. Griest, formerly assistant master mechanic of the Pennsylvania Lines West of Pittsburgh, with office at Fort Wayne, Ind., has been appointed master mechanic at that place, succeeding Mr. B. Fitzpatrick, deceased, and Mr. F. T. Huston, formerly assistant master mechanic at Pittsburgh, Pa., succeeds Mr. Griest.

Mr. Lewis W. Baldwin has been appointed general superintendent of the Illinois Central Lines south of the Ohio river, with office at New Orleans, La., and Mr. Lawrence A. Downs has been appointed superintendent of the Kentucky division of the same road, with office at Louisville, Ky., succeeding Mr. Baldwin, and Mr. William Atwill has been appointed superintendent of the Minnesota division of the same road, with office at Dubuque, Ia., succeeding Mr. Downs.

Mr. George F. Hinkens, who has been for a number of years in the employ of the Baltimore & Ohio, has resigned to enter the service of the Ingersoll Rand Company, reporting to the Philadelphia office. Mr. Hinkens served his machinist apprenticeship with the Westinghouse Company and later entered Purdue University. On the Baltimore & Ohio he was general foreman, and latterly assistant master mechanic, and at time of leaving was superintendent of the reclamation plant at Zanesville, Ohio.

Mr. J. P. Barry has been appointed master mechanic on the New York, Ontario & Western, with office at Mayfield Yard, Pa., succeeding Mr. W. H. Kinney, resigned. The position of general inspector in charge of air brakes, steam heat and lighting is discontinued, and matters relative to heat and lighting have been placed in charge of Mr. A. Kipp, general car inspector, while matters relating to air brakes will be in charge of Mr. B. P. Flory, superintendent of motive power, with headquarters at Middletown, N. Y.

Mr. James W. Chamberlain, engineer on the Boston & Albany, retired last month after a continuous service of 53 years and 7 months. He entered the service of the road on June 1, 1861, as a spare fireman, and in turn served as fireman, engineer, traveling engineer and road foreman of engines. In later years he has been engineer on one of the largest modern express locomotives. He retired with an absolutely clear record, which has never had a demerit for any cause whatever placed against it. His pension began on New Year's day, the good wishes of every man on the road go with him into his honored retirement.

H. W. COPE

Mr. Albert H. Harris has been appointed vice-president of the New York Central, and will perform such duties as may be assigned to him from time to time by the president, in addition to his duties as general counsel of the company. Mr. Harris is a graduate of the University of Rochester, and entered railway service in April, 1905, and has been consecutively general attorney and general counsel on the New York Central, also vice-president of the Michigan Central and Lake Shore & Michigan Southern, also vice-president of the Cleveland, Cincinnati, Chicago & St. Louis, and Chicago & Lake Erie, also vice-president of the Pittsburgh & Lake Erie.

Among the changes and promotions on the Atchison, Topeka & Santa Fe, Mr. William Harrison has been appointed general foreman at Newton, Kan.; Mr. W. W. Roloson, general foreman at Arkansas City, Kan.; Mr. B. A. Eldridge, general foreman at Chillicothe, Ill.; Mr. H. Gallagher, road foreman of engines at Chicago, Ill.; Mr. B. P. Phelps, engineer of shop extension at Topeka, Kan., and Mr. W. D. Hartley, foreman on the Coast Lines of the Santa Fe, at Baustou, Cal.

Mr. H. W. Cope, the popular and accomplished assistant manager of the industrial and power department of the Westinghouse Electric and Manufacturing Company at East Pittsburgh, has been appointed director of the exhibit of the company at the Panama-Pacific International exposition and is now located in San Francisco giving his personal attention to the work. Mr. Cope was born in North Vernon, Ind., and is a graduate of Purdue University of that state. Prior to his attending the university he was engaged in electrical construction and sales work. In September, 1898, following his graduation, he became associated with the Westinghouse Electric & Mfg. Co., with which company he has remained ever since. Mr. Cope took the apprenticeship course and was engaged in the engineering department in connection with the design of alternating-current switchboards, layout of power houses and substations, and in 1905 was made the head of the A. C. correspondence department. A short time after this he was made assistant manager of the industrial and power department, which position he held until the time of his transfer to the work in connection with the exposition.

Obituary.

The death is announced of Col. Edward D. Meier, formerly president of the American Society of Mechanical Engineers, at the age of 73. He served an apprenticeship in the Mason Locomotive Works, at Taunton, Mass., and made a notable record as a constructor and engineer on Western railroads. He was president of the American Boiler Manufacturers' Association in 1898, president of the American Society of Mechanical Engineers in 1910 and in 1913 represented that society in Munich at a joint meeting with the German Engineering Society.

Passing Events in Europe

By A. FRASER SINCLAIR

British Locomotives in 1914.

Few changes of an important kind were embodied in such locomotives as were turned out of British shops during the year 1914. It might almost be said that design was on the verge of stagnation, such improvements as were instituted for engines on some railways being but the incorporation in them of changes previously effected on other lines.

But if no material changes fail to be placed on record it has to be stated that there have been certain fallings away from grace tending to give the impression that the conditions of railway service in those islands are somewhat different from those in various foreign countries, or British locomotive engineers are at variance with the rest of the world. Thus we find that compounding so highly prized in Scandinavian countries is getting out of use with us, and in a few years, if matters progress as at present tending, will have disappeared. There may be something in our mild climate which prevents the full advantage of the second expansion being experienced, although steamship experience rather gives that theory the lie. It may, of course, be an indifference to what may be regarded as small economies, "the game not worth the candle" attitude, and the failure of the movement in favor of feed-water heating gives some color to this view. In considering the action of the British railway companies on any subject it must always be remembered that all competition among them is dead. The only competition with which they have to contend is that of the sea, and that is largely restricted to the carriage of merchandise.

Contrary to the experience with compounding and feed-water heating superheating makes steady progress. Railways which for long were decidedly conservative on the subject of superheating are now adopting it as quickly as the superheaters can be fitted. It is true that in some instances the change of policy has synchronized with a change of management, but that was, no doubt, merely an accident. The Schmidt device continues most in favor, and is fitted, in all probability, to as many engines as all the others combined, but there are others coming along and the supremacy of the device named may be challenged before [illegible]

This is not the place to recapitulate the additions made by the various railway companies to the numbers of their locomotives, but it may be mentioned that on the whole the additions were about normal. [illegible] had the effect of requiring more powerful engines and this has led to the order- [illegible] have been the case. The pooling of traffic by which all goods must go by the shortest route must have reduced the total haulage considerably, but that, of course, is not a thing to last.

Electrification of Railways.

While the conversion of railways in this country from steam to electric haulage is not at a standstill by any means it is far from making rapid progress. Only around the cities, chiefly London, does the substitution proceed with any degree of haste, and even in such districts the conditions are too difficult to permit of a rapid change.

As might be expected Switzerland tells a different story. No country in Europe is so placed by reason of natural advantages to utilize electricity for railway haulage as Switzerland. It was the first country in the Eastern Hemisphere to introduce electric lighting from its water power, and has gone on extending its benefits from that source ever since. I remember being in Switzerland a good many years ago—with the editor of this technical and erudite publication more by token—and was greatly struck by the tramway systems in small towns, and the electric lighting in villages. At that time in this country only large cities were capable of carrying the burden of tramways, while public electric lighting was equally scarce. Now we learn from the Italian paper *L'Industria* that it has been decided to convert 1,873 miles of Swiss State Railways from steam engine haulage to that by means of electrical power generated from the hydraulic wealth of the country. The people of Switzerland have some curious notions regarding the rights of land owners. With them the rain from Heaven is the property of all and there is therefore no compensation for disturbed water rights to be paid. However, that by the way. The first section will include the St. Gothard tunnel, the section being some 67.7 miles in length. Ample power from water exists, the only trouble likely to arise being from frost in very cold weather. Provision to cope with this obstacle has, however, been made and no real difficulty from this cause is anticipated. The current will be transmitted in single phase form at a pressure of 60,000 volts to various sub-stations whence it will be distributed at pressures varying from 7,000 to 15,000 volts. Some of the advantages of the change are, primarily, decreased cost of power. In the second place Switzerland will be rendered independent of foreign assistance in the form of coal on which she has hitherto had to rely, and in the last place the terribly trying pollution of the air in the St Gothard tunnel will be remedied.

Method in His Badness.

While passing by an old-fashioned inn the tourists were attracted by an ancient bagpiper, who was tooting atrocious sounds through an instrument that was both dilapidated and squeaky.

"Great Jericho, Sandy!" exclaimed one in desperation. "Why don't you have your bagpipes repaired?"

And the old man ceased playing and looked up in astonishment. "Havers, mon, ye dinna understand. If ma bagpopies wor in good tune the inn mon winna give ma two shillings to move [illegible]"

What He Got.

Some children were telling their father what they got at school. The eldest got reading, spelling, and definitions. "And what do you get, my little man?" said the father to a rosy-cheeked little fellow.

"Oh, I dets readin', spellin', and spankin'."

The Baby's Medicine.

The mistress of the house had been to a concert, and when she returned she was met by the servant with: "Baby was very ill while you were out, mum."

"Oh, dear!" said Mrs. Youngwife. "Is he better?"

"Oh, yes, mum; he's all right now, but he was bad at first. I found his medicine in the cupboard."

"Good gracious! What have you given the child? There's no medicine in the cupboard."

"Oh, yes, there is; it's written on it." And then the girl triumphantly produced a bottle labelled "Kid Reviver."

Trustworthy.

"Rufus, you old loafer, do you think it's right to leave your wife at the washtub while you pass your time fishing?"

"Yassah, jedge; it's all right. Mah wife don' need any watching. She'll sholy wuk jes' ah hard as if I was dah."

A colored preacher who had only a small share of this world's goods, and whose salary was not forthcoming on several occasions, became exasperated. At his morning service he spoke to his church members in this way—"Bredren and sistern, things is not as they should be. You must not 'spect I can preach on with you an' boa'd in [illegible]"

The blessedness of giving is not limited to cheques and bank bills. There are gifts that far transcend these—gifts of patience, sympathy, thought and counsel, and these are gifts that the poorest can give.

"Flakes," said Old Jerry, as he gazed meditatively at the falling snow, "used to bother the boys considerable. What, with the cold weather, gummy oil and the heavy storms, it was almost impossible to keep time. "Flakes," continued Jerry, "are all right if you know which kind to use. With a can of flake graphite Old 689 used to bore through those snow banks as if nothin' but white clouds was obstructin' the way. 'It's graphite, boys,' I used to say and nothin' but

DIXON'S FLAKE GRAPITE

will do it. And then I used to pull out that old Dixon ad and read them the magic line: 'Write for free sample and booklet No. 69.'"

Joseph Dixon Crucible Co.

Established 1827

JERSEY CITY, N. J.

RAILROAD NOTES.

The New York Central is inquiring for 44,500 tons of rails.

The Long Island has awarded 20 steel coaches to the Standard Steel Car Co.

The Union Pacific is in the market for 750 40-ton capacity steel underframe stock cars.

The New York, New Haven & Hartford, it is said, has ordered 20,000 tons of steel rails.

The Louisville & Nashville, according to report, has ordered 38,000 tons of rails to be rolled at Ensley, Ala.

The American Locomotive Co., it is reported, has closed an order for seven small locomotives for Servia.

It is understood that the Baldwin Locomotive Works has closed an additional order of locomotives for Russia.

The Southern Pacific is reported as placing contracts with the Tennessee Coal Iron & Railroad Co. for 30,000 tons of rails.

The Nashville, Chattanooga & St. Louis has ordered six Pacific and six Mikado locomotives from the Baldwin Locomotive Works.

The Philadelphia & Reading has placed an order for 10,000 tons of rails, the Pennsylvania Steel Co. obtaining a portion of the order.

Construction work at the Bessemer & Lake Erie shops at Greenville, Pa., has resumed. The steel car department will be doubled.

The Detroit United has placed an order with the Westinghouse Electric & Mfg. Co. for a 50-ton Baldwin-Westinghouse locomotive.

An effort is being made to reinstate the recent order for 30 locomotives placed by the Cincinnati, Hamilton & Dayton, but subsequently held up.

The Nashville, Chattanooga & St. Louis has placed an order for ten Mikado locomotives and six Pacific locomotives with the Baldwin Locomotive Works.

The Baltimore & Ohio has placed contracts for 1,000 hopper cars with the Cambria Steel Co. and for 1,000 box cars with the Mt. Vernon Car Mfg. Co.

The Atchison, Topeka & Santa Fe is in the market for 700 box and 500 refrigerator cars, and is expected to make inquiries for a total of over 3,000 cars.

The Illinois Central has ordered 25 Mikado locomotives from the Lima Locomotive Corporation. They will have 27 x 30-inch cylinders and will weigh 218,300 pounds.

The Lehigh & New England is receiving bids on revised plans for a one-story, 163 x 264-foot building to be erected at Pen Argyle, Pa., for use as a locomotive shop and storehouse.

The New York Central has ordered 20,000 tons of steel rails, dividing the order among the Steel Corporation, the Bethlehem Steel Company and the Lackawanna Steel Company.

The Cleveland, Cincinnati, Chicago & St. Louis has placed an order for five Pacific locomotives with the American Locomotive Co. It is said that this road is still in the market for equipment.

First steps in the actual construction of the new Union terminal station at Chicago, involving the expenditure of $65,000,000 and the employment of 20,000 men, probably will be taken in March.

The Pennsylvania has announced its rail requirements for 1915. It will need 170,000 tons of standard steel rails, and of this 150,000 tons will be 100-pound rails. This lot will be bought at once and bids have been asked.

The Oregon-Washington Railroad & Navigation Co. is to build a freight terminal at The Dalles, Ore., consisting of six switching yard tracks each 4,000 feet long, a 12-stall roundhouse, a machine shop 40 x 40 feet, a power house 40 x 60 feet, a store house 40 x 80 feet, water tanks, coal plant, cinder conveyor and turn tables.

A formal order has been issued by the public service commission of New York to the Interborough Rapid Transit Co. that the lines must be equipped throughout with all-steel cars by December 1, 1915. The substitution is to begin by May 1 and is to be completed by December 1. The number of steel cars that will be required will be 478.

Application will be made to the Dominion parliament at its next session for an act incorporating the Vancouver Terminal Ry. Co., and authorizing it to construct railway and terminal works and tunnels and transfer and connecting tracks with other railways between the cities of Vancouver and New Westminster, and the mouth of the Fraser river.

Books, Bulletins, Catalogues, Etc.

"National" Pipe.

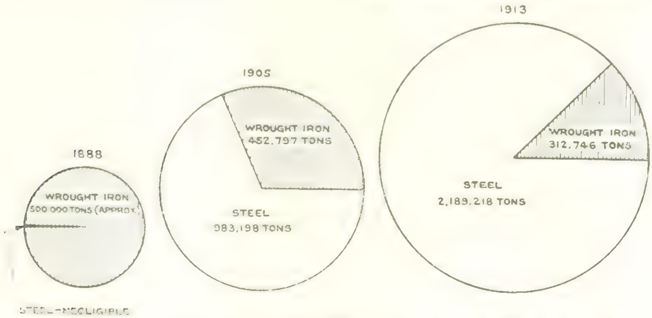
The National Bulletin No. 11 C presents the story of the development of the steel pipe in an admirably instructive way.

every page is luminous with intelligence. Early methods of manufacturing are shown in graphic illustrations from the crude bamboo tube of the Aborigines, and the pottery of the Egyptians, and the lead pipes of the Romans from which there was little departure until in 1812 an Englishman began welding pipes for various purposes. Murdock, the inventor of gas lighting, was compelled to look around for something durable and the barrels of guns used in European wars came to his hand. These were lap welded, but butt welding soon came into use. Among the

rapid during the intervening quarter of a century that at the present time the output represents about ninety per cent. of tubular material manufactured in America. The quality is also being constantly im-

entirely in National Tube Company's mills, a remarkable degree of uniformity is secured, until now between "National" pipe and pipe of wrought iron there is no comparison, the latter requiring much personal skill and attention to obtain even fair results, whereas in the manufacture of "National" pipe the work is reduced to a few highly trained men, the work being done entirely by machinery.

Even under the very best conditions the lap-welded wrought iron pipe, according to the published reports of American Society of Mechanical Engineers, rarely approaches 60 per cent. of the durability



early and most successful American pipe

the most enterprising and successful. After an interesting experience in New England the company settled in Pittsburg as the National Tube Works Company. Since then the word "National" has become not only of national, but of world-wide reputation.

The first great success of the company was in the producing of steel which successfully fills the severe demands made upon pipe by modern usage. To overcome the tendency to corrosion, especially in the smaller sizes of pipe, a special process known as Spellerizing was in-

"National" pipe. It consists of a system of rolling repeatedly, thereby producing a dense texture on the surface of the metal and the results, after several years actual trial, are of the best.

It was not, however, until 1887 that success became certain. Rigid inspection and tests clearly demonstrated the superiority of Spellerized steel pipe and

ever, is so sure a gauge of popular approval as the actual growing increase of the use of the improved article, and the annexed diagram shows the increasing use of steel as compared with wrought iron pipe during the last twenty-five years.

pany's "National" bulletins may be had on application to the company's office, Frick Building, Pittsburgh, Pa.

Master Car Builders' Report.

The report of the forty-eighth annual convention of the Master Car Builders' Association is so voluminous that it covers two volumes of 459 and 504 pages, respectively. Besides the 504 pages of reading matter the second volume contains large, folded engravings that represent an immense amount of skillfully executed work.

work done by the committees in prepa-

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ing the reports and discussing them after they were read. There were sixteen reports read and discussed, some of them at great length. The report of the Arbitration Committee, for instance, fills 51 pages while that on Couplers and Draft Equipment occupies 58 pages, with an appendix of 12 pages of illustrations and 11 pages of discussion. The discussions were not expressions of empty platitudes, but were noted for good, practical sense eminating from men who know the business on hand from alpha to omega.

The report on the Revision of Standards and Recommended Practice is a credit to the committee and fills 11 pages, which was supplemented by a discussion that covers 16 pages. In this and other discussions is strikingly illustrated the vast amount of practical information possessed by the master car builders of the country, men whose training school has been the workshop with tools of their trade for text books.

An important part of the volume is the report on the discussions of the Arbitration Committee, which fills 51 pages. This is a mass of decisions or recommendations concerning disputes that arose in the interchange of cars and are 136 in number. The careful study of these recommendations will enable men controlling the interchange of cars from falling into disputes that frequently lead to tedious correspondence and sometimes embarrassing decisions. This report is part of a mass of literature in course of production establishing rules for settlement of questions that arise in connection with interchange of cars. They cover almost every conceivable cause of dispute and it is likely that within a few years they will form a code of unquestioned authority.

Couplers and draft appliances were reported on to the extent of 58 pages, with 12 pages more of illustrations and 11 pages of discussions. That subject and Car Trucks provide subjects of almost illimitable discussion, and the opportunity for the members to spread themselves was not neglected at the last convention.

There was nothing of importance relating to car construction and maintenance left out, and all the discussions make excellent reading. In connection with this two-volume report, a Scriptural anecdote seems applicable. A certain teacher asked a Sunday school class, Who deserved the greatest sympathy in the story of the Prodigal Son? After some hesitation the bad boy answered, "the calf." We have been thinking that Secretary Taylor was the calf slaughtered in getting out this report.

Railway Master Mechanics' Association Report.

The report of the proceedings of the forty-seventh annual convention of the American Railway Master Mechanics' Association comes to us in two volumes, making an aggregate of 1,045 pages besides many double-page folders. The report is the most formidable record of a master mechanics' convention ever produced, and offers to the members a wide field for study or reading. The proceedings of the master mechanics' annual convention have been growing in size year by year, but the great increase in volume this year that called for two volumes was due to the long report of the Committee on Locomotive Headlights, which fills entirely the second volume. This important report is the work of a special committee of which Mr. D. F. Crawford, general superintendent of motive power of the Pennsylvania Lines West of Pitsburgh, was chairman. It represents an immense amount of scientific work, which is of the highest importance to all the railways in the country. We expect to make a special notice of Mr. Crawford's report when time permits.

The proceedings proper of the forty-seventh convention of the Master Mechanics' Association covers 660 pages, and besides the routine business embraces reports on design, construction and inspection of locomotive boilers; dimensions for flange and screw couplings for injectors; efficiency tests of locomotives; fuel economy; locomotive headlights; locomotive stokers; motors for railway shops; revision of standards and recommended practice; revision of train brake and signal equipment; safety appliances; smoke prevention; standardization of tinware; superheater locomotives; tests of Schmidt's superheaters and brick arch, and a few other subjects of minor importance.

Besides an unusual amount of reading matter in the reports they were nearly all profusely illustrated by engravings which have served to greatly increase the size of the volume.

The discussion on the floor of the various reports will be found extremely interesting and full of facts worth remembering. It may seem ungracious to commend any particular lines of talk, but we were particularly impressed with the discussion on fuel economy, on locomotive stokers, on smoke prevention, and on superheaters and the brick arch.

To go over this annual report for the purpose of identifying its strong points is to exercise patient labor, what must have been the weary toil of preparing the matter for the printers. It was our duty to edit ten of those reports and it was no jubilant labor when the report covered little more than 200 pages. The present report of

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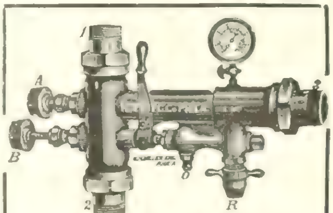

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[illegible] poor Joe Taylor.

Railroad Strangulation.

[illegible] the Pennsylvania Railroad Company, delivered an able address before the Men's League, at New Brunswick, N. J., lately, and it is now published in pamphlet form. It is particularly worthy of the attention of our legislators who seem singularly adverse to railroad development. Mr. Lee contends that the railroads in this country are caught in a vise which is being screwed tighter and tighter. Railroads do not oppose proper regulation, but is it not time to inquire whether regulation is [illegible] Many are the signs now that the grip of cumulative regulation is slowly but surely squeezing out the life blood of what President Wilson has called "the one common interest of our whole industrial life"; that it is scotching initiative and enterprise; and that it is undermining the ability of the railroads to provide for future public needs.

In our treatment as a people of the railroad question we are obeying literally the scriptural injunction: "Take no thought for the morrow." "The railroad is here," we reason; "it cannot run away; let us get all we can out of it now, because—may be, its stock is watered!"

Graphite.

Among the most comforting publications that come to us the Joseph Dixon's Crucible Company *Graphite* is in the front rank. It does not admit the continuance of hard times but states that business is getting better in this country every day and we confidently look for steady and continuous improvement. Our business is [illegible] cerns with which we are closely ac- [illegible] houses are experiencing difficulty in pro- [illegible] restricted by credit limitations; still others [illegible] proposed or actual legislation. But, annoying as all these things are, they are more or less transient and are not suffi- [illegible]

Gasoline Engines.

The Norman W. Henley Publishing Company, 132 Nassau street, New York, have just published a revised and en- [illegible] four cycle gasoline engines. The author, [illegible] nish information to the busy man who uses a marine engine for pleasure or profit, but who does not have the time or inclination for a more complete technical book. The instructions given are ample to enable any person to properly install, care for and operate his own marine engine. The work extends to 100 pages, is fully illustrated and is sold for twenty-five cents.

Smithsonian Institution.

Anything in book form more stale, flat and unprofitable than a government report would be hard to find in the realm of literature. There are exceptions among which is the annual report of the Smithsonian Institution just issued. It is a cyclopedia in its way and contains much that is of real vital interest. It adds to the golden fringe of science. It tells of prehistoric man. It circles the belt of Orion. It touches and illuminates almost everything. All that one needs is time to peruse its 804 pages, then the reader could take his place among the scientists of our time. Copies may be had from the Government Printing Office, Washington, D. C.

Flexible Staybolts.

An interesting record of complete installations of flexible staybolts appears in the last issue of the Bulletin of the Flannery Bolt Company, Pittsburgh, Pa., which is well worth the serious consideration of all interested in boiler construction and repair. During the past year many fire boxes have been converted from the rigidly stayed condition, obtaining a complete installation of the Tate Flexible Staybolt. Quite a number went through the several locomotive plants and others were handled by the railroad shops that had the facilities, the work being easily accomplished under systematic and careful supervision and most satisfactory results were obtained in the quickness and completion of the work.

Several hundred new boilers are now in service with a complete Tate Flexible Staybolt installation, and the most satisfactory reports are obtained as to their service and economy of maintenance.

Lucky Inventions.

[illegible] with an india rubber tip cleared £20,000, and the designer of the piece of india rubber for shoe heels retired with a fortune of £160,000. The revival of Diabolo, a game known under the Directorire, is [illegible]

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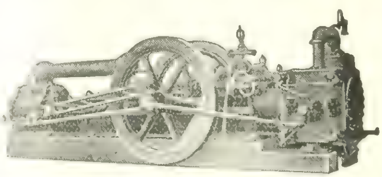
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Railway and Locomotive Engineering

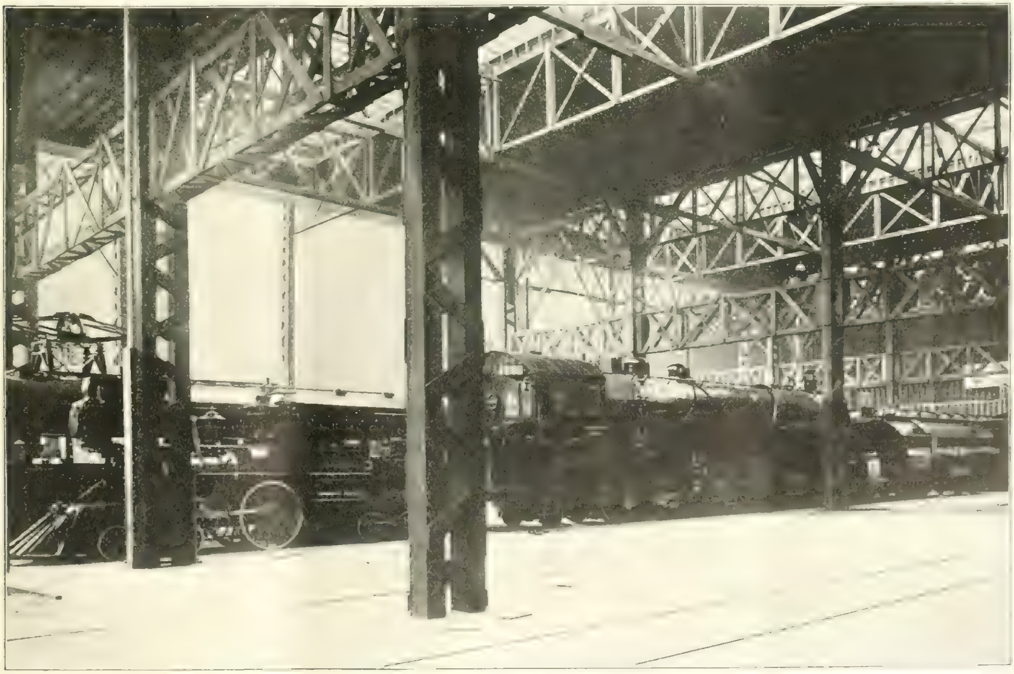
A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVIII. 114 Liberty Street, New York, March, 1915. No. 3

Palace of Transportation Panama Exposition

Our frontispiece illustration is a view of the interior of the Palace of Transportation at the Panama-Pacific International Exposition, San Francisco, California, and which was opened last month and will remain open until next December. The building devoted to transportation is the second largest of the eleven gigantic exhibit buildings, and measures 579 feet by 614 feet, the exhibit area amounting to over 314,000 square feet. Almost every known type of locomotive is on exhibition. Those shown in the illustration are modern types of Southern Pacific engines on the right, and what is known as No. 1 of the same road, or the little Huntington Engine, on the left. Beyond the Huntington with its single driver, is one of the electric locomotives.

A fair view of the remarkable structural work is shown in the picture, but it would be impossible for any picture to give anything but a faint idea of the magnitude or variety of exhibits coming under the heading of transportation and all displayed in one building. Many of the details shown are amazing in their minuteness. The handling of passengers, ticket office management, emigration and colonization bureaus on railroads, and methods of freight transit are illustrated in the various railroad exhibits. Methods of dispatching trains, operations of yards, methods of preventing injury to persons and accidents to freight and baggage, and also the modern safety devices in use on the American railways are being displayed and exhibited.

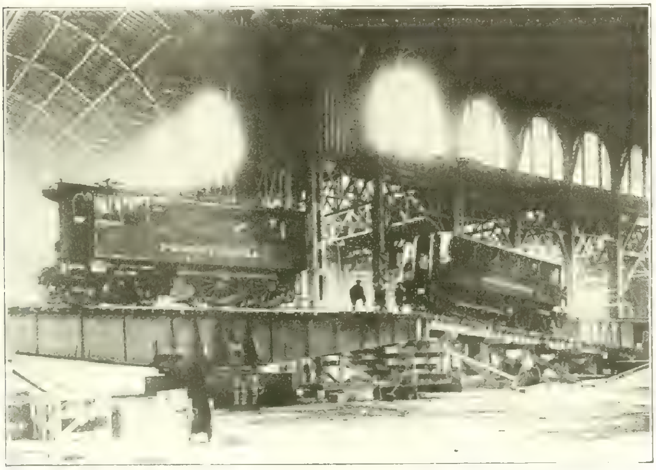


INTERIOR VIEW OF THE PALACE OF TRANSPORTATION AT THE PANAMA-PACIFIC EXPOSITION [illegible] SAN FRANCISCO, CAL.

An interesting exhibit is that of the Westinghouse Electric & Manufacturing Company, which includes one of the Pennsylvania Railroad locomotives mounted on a turn table. The location of the turn table is under the center of the dome of the immense Transportation Building at the junction of the two main aisles, thus bringing it in

full view. Crowds will be expected to pass through this building, which will contain a large number of exhibits of great interest to the public at large.

Some idea of the vast size of the building may be gathered from an authentic story told of an erecting engineer who endeavored to locate the center of the building with his eye by standing under the dome, which seemingly was an easy task. When accurate measurements were afterwards made to verify this, it was found the point previously selected was 12 feet off from the actual center. The turn table is 65 feet long and weighs 440,000 pounds, including the locomotive. The height of the track is 12 feet above the floor, and steel ties are used, a new type of construction for this class of work. By means of 10 horsepower, 3-phase 220 volt motor the turn table is



ELECTRIC LOCOMOTIVES AT THE PANAMA-PACIFIC EXPOSITION.

caused to revolve at a speed of once in three minutes, thus giving the crowds in each end of the building different views of the locomotive. The rotation, which can be reversed in direction, is under the control of the operator located in a booth nearby.

A decidedly unique method of collecting the current for lighting the locomotive is employed. This was designed by the Westinghouse engineers and involves bringing the leads up through center bearing, to collector rings, thus obviating the use of third rail shoes or trolleys. The locomotive is arranged and lighted so as to permit the people to pass through it and inspect the equipment. It is clamped to the turn table by means of steel bands so as to prevent any possibility of its becoming dislodged in the event of an earthquake. This locomotive is said to be [illegible] service. It consists of two units and weighs 156 tons, and is the first side-rod gearless locomotive ever placed in service. It is equipped with two motors having a total capacity of 4,000 horsepower, and Westinghouse unit switch control equipment of the HBF type, which has made the phenomenal record of 99,549 miles per train without delay power control failure. Twelve million passengers annually are transported over the electrified terminal of the Pennsylvania Railroad from Harrison, N. J., to Pennsylvania Station, New York City, by these locomotives, which are capable of attaining a speed of 60 miles per hour with full train.

In addition to the locomotive, the newly developed types PK and HL control for railway motors will be shown in actual operation. These control equipments will operate motor racks equipped with 40 horsepower motors. The PK control operating head can be applied to any standard type K controller. A complete line of commutating-pole railway motors, including box and split frame types for various voltages from 600 to 1,500, will also be shown, and in addition a preliminary sample of the new pressed steel railway motor.

Award for Safety on the New York Central Lines.

On February 11 the E. H. Harriman Memorial Gold Medal for the American Steam Railway making the best record in accident prevention and industrial hygiene affecting the public and its own personnel during the year ending June 30, 1914, was awarded to the New York Central Railroad. The award was made to this road for its record on the New York Central and Hudson River Railroad prior to its consolidation with the Lake Shore. The medal was offered by Mrs. E. H. Harriman to be awarded through the American Museum of Safety.

The record of the New York Central for the year was considered remarkable in many respects. The progressive steps taken in the installation of block signals, improved roadbed, steel equipment and modern safety devices were taken into consideration, as well as the actual record of accidents. There has not been a passenger killed in a train accident on the road in four years, during which time the number of passengers actually carried on its trains equals approximately twice the entire population of the United States. Nearly three million freight and passenger trains were operated day and night in all kinds of weather. During the year ended June 30, 1914, as compared with the previous fiscal year there were 102 fewer persons killed and 1068 fewer persons injured as a result of the safety work on the road.

The presentation of the medal was made in the United Engineering Society Building, New York City, and was received in behalf of the railroad by Mr. Alfred H. Smith, President.

Japanese Locomotive Engineering.

A new era in the annals of Japanese engineering was marked recently when a successful trip was made of a new locomotive for the South Manchurian Railway. This engine, which is the first standard-gauge locomotive to be designed and built by Japanese engineers, was constructed in the company's shops at Shahokou, near Dairen, the terminus and headquarters of the railway, and one of the most flourishing ports in the Far East. It is true that Japanese-built engines are already in use on the Imperial Japanese Government Railways, but these are all narrow-gauge lines. The Shahokou shops, which were only opened in 1911, are naturally on a comparatively small scale. They are, however, well equipped with modern machinery and up-to-date appliances of all kinds, and employ nearly 3,000 hands. The shops are now constructing five more engines of exactly the same design, as well as six double-ended tank-engines for the Chosen (Korean) Government Railways. Moreover, it is intended gradually to increase the capacity of the works to construct new locomotives and carriages.

Dog Railroad in Alaska.

The furthest north railroad in the world is said to be that between Nome and Kougarok in Alaska, a distance of eighty miles. The government imposed a tax of one hundred dollars a mile per annum on the road, and the road failed to pay expenses. A mail contractor,

named Peter Yaeger, leased the line, and he constructed light cars that ran on four wheels, and with a motive power of from ten to fifteen dogs he had hauled several tons of freight and mails and made the round trip once a week. Now the government is projecting a railroad that will run from Nome to the Alaska coal fields. This will bring the price of coal down from $20 a ton to about $3 or $4, and it is expected that the Seward Peninsular Railroad again will become a steam railroad instead of a dog road.

For five years coal has been brought from British Columbia and Australia and has been extensively used in thawing out the frozen ore and gold deposits. Many of the mining plants use coal also, although much fuel oil is being introduced.

European Railroads.

According to Mr. Irvin S. Cobb, who has recently returned from an extensive European trip, and resumed his occupation as a leading New York journalist, the so-called de luxe modern, first class Continental trains, with the exception of two or three special trains, are about what the service was on an accommodation, mixed freight and passenger train in the State of Arkansas immediately following the close of the Civil War. Everybody may not agree with Mr. Cobb because he has peculiar views of his own, but there is a strong element of truth in all of his unique statements. In regard to the European war he says that there is no war, but an extensive siege, with the armies standing away back as far as possible from each other. He prophesies, however, that they may come to grips before another winter.

Railways in Rhodesia.

The traffic on the Rhodesian railways was extremely good last year owing to a large expansion in trade and settlement in the districts between Bulawayo and Salisbury and also in the Belgian Congo. Large importations of machinery have been made. An important source of recent traffic has been the rapid extension of the copper mining industry. Furnaces with a capacity of 1,000 tons of copper per month are at work and further additions are being made.

The Union Minière du Haut Katanga, which owns the Katanga mines, has contracted to take its fuel supplies from the Wankie colliery for a period of ten years, the minimum quantity of coal and coke under this contract being 100,000 tons per annum. The whole of this large traffic will pass over the northern sections of the Rhodesian system, while the copper will be carried from the northern frontier of Rhodesia to the sea at Beira.

Armored Trains in War.

It may be interesting to note now that armored trains are traversing the battle fields of Europe, that the first armored train was used during the Egyptian campaign of 1882. The train was put in service during the reconnaissance in force against Arabi Pasha's troops, and was employed on the Abouker-Lake line. The car employed was a truck protected by boiler plates, and armed with a six-inch rifled gun and a couple of Gatling guns. This armored vehicle was pushed ahead of the locomotive.

The Simplon Tunnel.

The Simplon Tunnel is the longest not merely in Europe, but in the world, its exact length, inclusive of the two short curves at either end, being 12 miles 537 yards. For about fifty years before its piercing engineers had been speculating as to the possibility of such an undertaking. By 1898 work was actually begun, and the whole tunnel was ready for traffic by May 19, 1906. The cost amounted to £2,940,000.

The north portal of the Simplon is about one mile from Brigue station, in Switzerland, and the south portal about half a mile from Iselle, in Italy, the frontier being crossed in the tunnel itself, more than half of which is in Italian territory.

The Simplon is the lowest great Alpine tunnel, the highest elevation reached by it being only 2,313 ft. It was originally built with a double gallery, connected by cross shafts every 220 yards, the two galleries being 56 ft. apart. One gallery alone was at first finished, and only a single track laid. The second gallery, however, will soon be completed and ready for traffic.

During the construction of the Simplon, the workmen suffered intensely from heat, owing to the number of hot springs tapped and to the temperature of the rock. The thermometer at times rose to 127 degs. Fahr., and the arrangements for ventilation by means of the continual introduction of fresh air proved insufficient, so that the air had to be cooled in advance of the boring party by being sprayed with icy cold water.

The enormous weight and stupendous pressure of the mountain overhead also caused much trouble, the pressure having been such as to distort the strongest wooden beams and warp the most solid iron supports.

During the boring of the Simplon Tunnel only forty-two lives were lost—a small number, considering that it was eight years in construction, and especially small when compared with the 177 lives lost on the St. Gothard, which took nine and one-half years to build. Owing to the Simplon having been begun after considerable experience of great Alpine tunnels had been acquired, it was far more rapidly constructed than any of its predecessors. The traction in the tunnel is electric, trains taking from twenty to twenty-five minutes to pass through.

Half way through the tunnel, at a point where there are 7,000 feet of mountain overhead, a station has been built, not for passengers, but for signaling purposes, two railway officials being constantly kept there. At this station, also, a slow train can be shunted on to a siding, in order to allow an express to pass. So well supplied is the Simplon Tunnel with fresh air that the men in the central station can remain on duty for eight consecutive hours without feeling any ill effects.

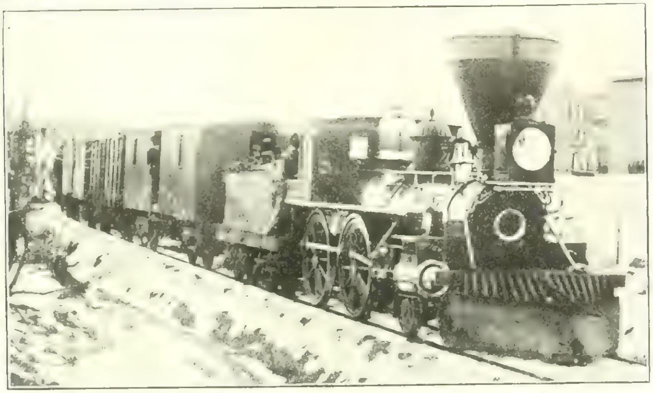
ELECTRICAL INSTALLATION OF THE SIMPLON RAILWAY AT ISELLE, ITALY, AT THE ENTRANCE TO THE SIMPLON TUNNEL.

General Correspondence

Another Old Timer.

By Andrew J. [illegible], New York.

It is always a delight to the older school of railway men, high or low, to see that Railway and Locomotive Engineering occasionally recalls from the interesting past some locomotive famous in its day, [illegible] now almost a vanished memory. As links in the great chain of locomotive development they have a place that will live in the undiscovered future. I recently secured a photograph of an old wood burner, named the Palisade No. 4. The photograph was taken at Monsey, N. Y., in 1867. This engine did excellent service on the Northern Railroad of New Jersey, now part of the Erie system, and was built at the Rogers Locomotive Works, Paterson, N. J., in 1862, for use in passenger service. The engineer, Mr. James Powles, is shown in the cab of the engine. The conductor, Mr. Abram Blauvelt, known as the "Dominie," from his clerical appearance and manner, one of the best known railroad men of his time in the United States, is shown in the second car. The photograph I had from Mr. William Blauvelt, son of "Dominie" Blauvelt. The younger Mr. Blauvelt is [illegible] on the Northern Railroad of New Jersey, and amply sustains the popularity of his [illegible].



PALISADE No. 4, NORTHERN RAILROAD OF NEW JERSEY.

Tractive Effort Simply Explained.

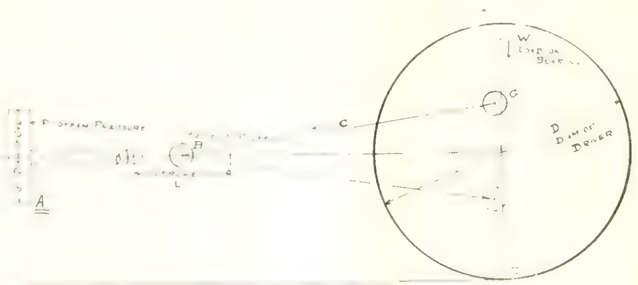
By [illegible], In-structor, Erie R. R., Port Jervis, N. Y.

It will be understood that tractive effort must be equal to resistance [illegible]. A simple method of arriving at the value of tractive effort for simple locomotives is as follows:

In the figure A is the piston and B and C the crosshead and connecting rod. When the wheel is revolving in the direction shown, for forward motion, and the piston moving in direction *P*, owing to steam pressure acting upon it, the crank-pin *G* is pulled downwards towards the horizontal center line. At the same time the weight on drivers *W*, on axle bearing, acting downwards, keeps the wheel tread in contact with the rail under a pressure equal to *W*. The pressure causes a frictional force *fw*, "f" being the coefficient of rolling friction, or, as it is always called in reference to adhesion, the coefficient of adhesion. Owing to the force acting on crank-pin, we have, by principle of the lever, a force acting at the tread of the [illegible] equal to [illegible] pressure multiplied by the length of crank-pin arm and divided by the semi-diameter of the wheel. This acts in a direction contrary to *fw*, and is, as we shall presently show, the measure of tractive effort or drawbar pull. Now when *fw* is equal to, or in excess of, the tractive effort, the wheel will act momentarily as if fulcrumed at *E*, and the pull on crank-pin will cause the center of axle to advance towards *A;* in other words, the engine moves forward. The position of the fulcrum with regard to the tread of the wheel is continually changing. We, therefore, get a combination of two motions: one, a movement of the wheel center in a horizontal direction, and the other, a circular movement of the wheel about its center. This is, in effect, what takes place whether the crank-pin is above moving towards A, or whether it is below moving from A. The locomotive then moves forward as if propelled by a horizontal force equal to tractive effort. If, however, the pull of the train—that is, the resistance—exceeds the tractive effort T, then movement cannot take place. Also, if the tractive effort is greater than "fw," the point E will no longer serve as a fulcrum, and the wheel will then simply revolve without moving the locomotive; in other words, slipping will take place. Therefore

Force of adhesion "fw" must be greater than tractive effort "T" or resistance "R," *or* fw must be greater than T or R.

Now, while the wheel of diameter *D* is making one complete revolution, the piston makes two strokes of length "L" under the mean effective steam pressure P per square inch. Hence the work done in one cylinder during one revolution of [illegible] is $2 \times (\frac{\pi}{4} d^2 \times L \times P)$, where [illegible] diameter of cylinder [illegible] L =



[illegible] EFFORT OF LOCOMOTIVE

length of stroke in inches. But there are two cylinders in the locomotive, hence the whole work done by the steam during this time is $= d^2 \pi L P$. Now, while the driving wheel makes one revolution, the center of the axle, if there is no slip, moves forward a distance π D, and the work done is $= \pi$ D T. Equating these two values of the work done we obtain

$$d^2 \pi L P = \pi T D$$

$$\text{therefore } T = \frac{d^2 L \times P}{D}$$

Considering Compound Locomotives: To calculate the tractive effort of compound locomotives the following conditions are taken:

d = diameter of low pressure cylinder.
T = tractive effort.
D = diameter of drivers.
p = boiler pressure.
s = stroke of piston.

Then $d^2 = \frac{4 T \times D}{p \times s}$, from which T,

FIG. 1

the tractive effort can be easily found. In general, the low pressure cylinder diameter is made 1½ times the diameter of a simple locomotive of equal power, the steam pressure being increased 10 per cent.

Force of Adhesion: In order to utilize fully the tractive effort sufficient adhesive weight must be provided. It is, therefore, necessary to know the value of the coefficient of adhesion. This varies between ⅓ to 1/10, but in general it is taken as ¼. We now have $\frac{d^2 L P}{D} = \frac{W}{4} = R$.

W in general will be the weight on driving wheels only. It is evident that the greater the weight on drivers the less the chance of slipping. It follows then that a locomotive having 400,000 pounds total weight on driver cannot exceed a pull of $\frac{400{,}000}{4} = 100{,}000$ pounds, except under very favorable conditions. If R. the resistance of the train, exceeds this 100,000 pounds, a helping engine must be used.

Shipping Air Brake Parts.

By F. W. Bentley, Jr., Missouri Valley, Ia.

The air brake department in connection with a division shop of any moderate size

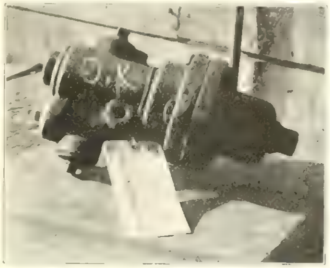


FIG. 2.

is generally of necessity a shipping depot of repaired parts to outside points and roundhouses. In volume, the amount of air brake repairs required by outlying points is not sufficient to require specialization at such places, and the demand for brake parts is fulfilled by the main shop where the air work is necessarily and economically specialized.

Approaching the subject another fact to be considered is that the majority of shipments of air brake accessories are made on passenger train, as outside points call for this material only when it is needed and that generally as soon as it can be received. Trainmen and baggagemen who handle the parts do not, as a rule, have much of an idea of the sensitive nature of such material, and it only too often arrives for use in just as bad a condition as that to be sent back for repair. From observation of not a little trouble experienced through considerable necessarily forced and hurried shipping, the writer has adopted a few methods in the preparation of air brake material which has satisfactorily attended better

FIG. 3.

results and less work in connection with the air brake department.

The slide valve feed valve is a part very quickly rendered defective by carelessness and improper handling in shipment. Any small amount of foreign matter which easily enters the large port openings is readily fatal to the operation of the valve, no matter how carefully it may have been repaired and tested out. Fig. 1 shows a method by which feed valves can be economically and safely protected against almost any conditions that would damage them in shipment. The small wooden strip or block is quickly applied to the valve as it is set out, and returned with the defective one.

It is not an uncommon occurrence for a baggageman to unload a number of engine triples with the same vehemence that trunks and suitcases are disposed of. The writer has seen them shoot out of a sidedoor and go rolling along a gravel covered station platform with the velocity of shrapnel. If the matter was further investigated, this would be found the direct cause of not a few engine failures at outside engine houses, where repair work is done by hostlers and other employees whose mechanical ability is not comprehensive of what might occur to an unprotected triple in shipment. Proper plugging of the three connecting aper-

FIG. 4.

tures, as shown in Fig. 2, is a simple precaution, yet it affords almost an iron-clad protection for the triple no matter who handles it or how.

The distributing valve is not the recipient of so much rough usage primarily because of the fact that it is an unwieldly and heavy proposition, and cannot be as freely handled as other parts without a considerable element of danger. The numerous openings on the gasket face are nevertheless subject just as much to the entrance of dirt and foreign matter injurious to the sensitive interior parts. Fig. 3. shows a simple wooden block for the protection of the valve, and which the writer has applied to emergency [illegible]

Fig. 4 is descriptive of a method of preparing the G-6 brake valve for shipment. The capping of the trainline and main reservoir connections is supplemented by the removal of the equalizing T and the plugging of the ½ inch opening in the body of the valve. The brass T fitting is a part not uncommonly broken off and it will be noticed securely wired

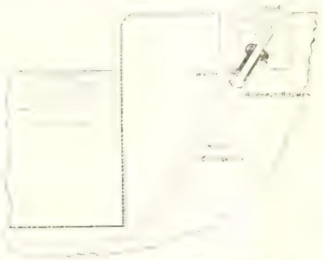
to the valve under the feed valve attachment.

There is an old saying, "A stitch in time saves nine." It is just as true with respect to the shipping of air brake material, for a plug or cap applied beforehand will often prevent a serious engine failure, much unnecessary correspondence, and perhaps some deserving employee from losing his position.

Conduit for Power Cables.

[illegible] Mark Mich.

The accompanying illustration shows a 6-in. cast iron conduit, laid under canal for power cables. It was found that the



CONDUIT OF POWER CABLES.

conduit was condensing the entering air, in which a large amount of water accumulated; the cables are lead covered, but when the lead cover is in good condition the water does not do any damage; otherwise it may happen that the lead sheeting is little damaged by pulling through, but certainly the effect of the water is injurious. We tried to stop the water condensation by sealing up the conduit ends with asphalt bitumen. A piece of clean waste was put into the conduit about 12 ins. from the end, to keep the bitumen from running too far down in the conduit, and the asphalt [illegible] ends fixed up to make a nice looking job, and [illegible]

Fitting Packing Rings in Differential Pistons.

[illegible]

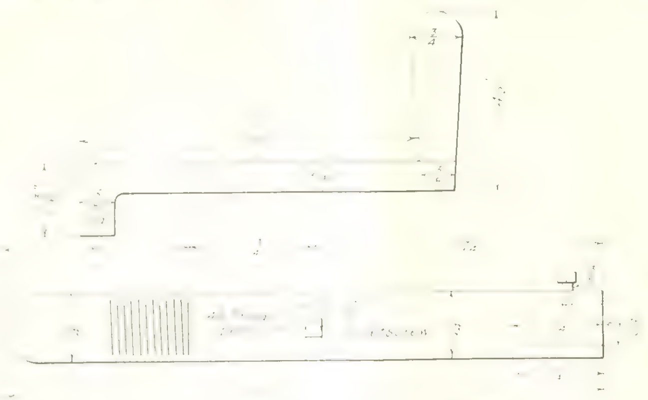
in your valuable publication recently regarding the correct method of fitting piston rings in air pumps, and thinking some of the readers would be interested in an accurate and rapid method of fitting the rings to the main valve bushing and left main valve cylinder head of 9½ Westinghouse pumps, I submit a method which I have used for a number of years, together with an inexpensive and practical tool for reboring the main valve [illegible] of discarded material in a few hours at very little expense.

The boring bar (Fig. 1) is made, according to the sketch, out of an old steam piston rod. The crank (Fig. 2) is made of soft steel and the handle of brass, according to the dimensions given. The right main valve cylinder head is an old head faced true on both sides and bored out for a neat fit on boring bar. Two slots are cut for the purpose of observing the operation and calipering the bushing.

The left main valve cylinder head is faced only on one side and is turned and threaded for standard stuffing-box nut. It is beveled at AA to receive one round of soft pump packing, which, with the gland and the stuffing-box nut, forms the feed mechanism of the boring tool. Four washers are made and are placed between right main valve cylinder head and face of main valve bushing, using four cap screws No. 1,879, to bolt same on with. A brass bushing serves as a guide for the boring bar, and it is not necessary to set this bar when this bushing is used. The outside diameter of this bushing is determined by the size of the bore in the left main valve cylinder head.

I might also add that the left main valve cylinder head is re-bored in a lathe, as we find this much quicker than reaming by hand. The tool used in the boring bar is ⅜ in. steel and can be made of round or square material and ground to give the best results, as the walls of the cylinder must be bored perfectly smooth.

We first ascertain size of last differential piston used and bore cylinder accordingly, increasing sizes by thirty-seconds. After cylinder has been re-bored, have the left main valve cylinder head re-bored for small piston in proportion



[illegible] WESTINGHOUSE [illegible] PUMPS

to size of large piston, increasing it also by thirty-seconds, and see that the sizes of these pistons are maintained in proportion. When the cylinders have been bored to receive the largest piston, they are bushed back to their original standard dimensions and the old pistons used again. In fitting the rings, file them so they will [illegible] and touch up the high spots with the file, after which they are assembled in their respective piston grooves and pistons placed on stem and a tool is used to grind them in with, using a fine grade of Trojan grinding compound for this operation. A stop made of a few washers and cap screws is used to prevent the piston from leaving the cylinder during the grinding operation.

The slide valve is spotted to a bearing on a face plate and the seat is faced to a bearing by the slide valve after which the valve is ground in.

A top head overhauled in this manner will always give satisfaction and cuts the repair bill in half, as it is about the only

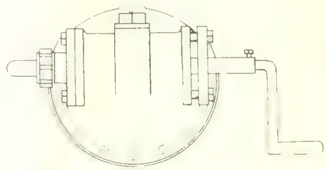


FIG. . BORING BAR APPLIED TO WESTINGHOUSE AIR PUMPS.

practical and economical method of making such repairs in the average railroad shops. Fig. 3 shows tool in position for re-boring main valve bushing.

Diesel Locomotives.

By A. Fraser Sinclair.

A rather interesting departure was announced in a Continental paper some little time ago, that is to say that an attempt was being made to adapt the Diesel engine to locomotive purposes. The proposal was in favor of the two-cycle form of the high compression machine. The Diesel engine has had rather a setback in Europe during the last twelve months for all but marine purposes, but it was beginning to [illegible] up somewhat when this calamitous

war broke out. The proposal referred to was very likely one of those antebellum developments. But it is very doubtful whether the Diesel engine would be a success for railway work. Its chief attraction to railway management must be in its very great economy, and one can understand that in southeastern Europe, where oil is plentiful and coal is dear, an oil-using engine must present very special allurements to a harassed locomotive manager. Nevertheless there are grounds for grave doubt regarding the success of such a proposition. Whether of the two or four-cycle form, the Diesel engine must be constructed with the most minute micrometric care, and in use the close fitting of working parts must be maintained. Obviously with a pressure in the cylinder head of 500 lbs. per square inch, while the temperature of the compressed air attains to 1,000 degs. Fahr., any play between the piston and the cylinder wall must be a source of serious waste. Now, while for stationary and marine work such pressures may be withstood for considerable periods, the case is rather different where locomotives are concerned. Stationary or installed on the bed in a ship's bottom, the machine is free from the jolts and jars peculiar to rail travel, motion and action, which must tend to more rapid wear than under the more favorable circumstances. Nevertheless the tremendous economy may lead to some modification of the present form of the Diesel to fit i for railway work. Messrs. Sulzer Brothers are alleged to have found a saving of something like 75 per cent. in an experimental engine which they constructed, and in those figures there is an inducement to spend on experiment. It may be that electricity intervening may better conditions for the high compression engine, but even then there is great doubt whether the necessarily finely regulated mechanism would withstand the rough and tumble conditions of railway work. Besides, Diesel castings are exceedingly heavy, the cylinders have to be robust on account of the high pressures—the fuel being injected at a pressure of 800 lbs. per square inch and with a dynamo or batteries super-added, the prime mover might be too heavy for its tractive power.

Miniature Railroading in the Tropics.

By L. Lodian, M[illegible]

It is nigh thirty years ago that one warm morning the beautiful view of Funchal (Madeira) gradually came in sight, on a trip from the north to the Plata. The liner coaled here—which permitted of a day's stay on the isle—or part of it. But the cog-wheel railroad depicted in the illustration, was unknown then; transit was in ox-drawn sledges which slid easily over the smooth pebble narrow ways.

Of all the innovations in Madeira during recent years, this rack-railway caused the most local comment. It is just over 4 kilometers long (2½ miles), with gradients varying from 16 to 25 per cent. It runs—or mounts—from near tide-level to the "monti," at a trifle over 1,000 m. elevation (some 3,300 feet), the cuttings passing through a wealth of tropical vegetation, and affording a ne'er-to-be-forgotten panorama.

The railroad was built by a company of the Portugal Republic, with head office at Lisboa, called "Companhia do Caminho de-ferro do monte." There are half a dozen services daily in each direction, with three stations. Time, either way, ½ hour.

A feature of the service is that—Funchal deriving part of its prosperity from the one-day-stopover passing tourist traffic, and the hour of arrival of the liners being uncertain—special trains are kept in readiness for their accommodation, at double the ordinary tariff rates. Thus, the return trip to the "monti" costs the transient the equal of $2 American currency, or 40 cents per mile going and returning. A cute way of "making money while the sun shines" out of the globe-circler, but it makes the investment of the Portugal Republic company safe and *paying!*

It has an excellent parallel at Pike's Peak, with this difference that one is not compelled to have a photograph taken at Madeira.

RACK RAILROAD AT FUNCHAL, MADEIRA

Railway Trespassers.

From statistics compiled by Mr. Ralph C. Richards, the acknowledged "Father of Safety First," it appears that in 24 years there have been 108,000 people killed and 117,000 injured through walking on railroad tracks in the United States. It was the general impression that the large majority of persons killed and injured in this way were what are known as tramps. This gross error has recently been corrected from statistics collected by Mr. Marcus Dow, manager of the Safety Department of the New York Central Lines. Only a small number are tramps or vagrants. They are not so easily killed. It is the common people that sustain this appalling loss, but it is gratifying to know that the slaughter of the innocents is being decreased and it is to be hoped that it will continue to decrease until the safety of the American railroads will compare favorably with those of Great Britain and continental Europe.

Primitive Methods in Chilian Railways.

In general construction work in Chile, such as ditching, building of dikes and levees, and railway cutting, the material is generally moved by hand, and it seems that there should in time be a market for American grading machinery, such as slips, wheelers, fresnoes, road graders, elevating graders, and the dump wagons that ordinarily go with them.

Air Brake Tests

By WALTER V. TURNER

Second Article.

[illegible]

In submitting the second article on the subject of air brake tests, from the able pen of Mr. Turner, it may be proper to state the rules contained in the following article should be carefully studied in connection with those appearing in the first article. In a communication from Mr. Turner, he states that, "While these may be added to with the intent of insuring greater trustworthiness in experiments, they cannot be subtracted from and any one making either experiments or tests without observing the principles and rules laid down, will probably find that they have not only misled themselves, but possibly others. Of course, much more than these principles and rules are required to qualify one for making either tests or experiments, for obviously they would be useless to a Hottentot or a Fiji Islander. The personal equation in every respect must be entirely submerged in so far as prejudices or interests are concerned, for the conclusion to be valid must be impersonal. This is such an intense conviction on my part that I have no mercy on either myself or others when I find personal desires entering or influencing conclusions, and while this is very hard on my personal desires and opinions at times, I derive much satisfaction from believing that it is because of this that I have succeeded in my air brake work."

It is not necessary to add anything to Mr. Turner's comments further than to emphasize the fact that coming as they do from one who is perhaps the foremost living authority on air brakes they can- [illegible]

[illegible]

(1) Do you know what the device is [illegible]

(2) Do you know what it *must* do from its design?

[illegible] the test?

[illegible] ing the result you get.

(7) Be *always* on the lookout for variations in the device from what is *intended* in the design.

[illegible]

[illegible] *faults* of test *apparatus* and *materials*.

(10) Be *sure* you *do not* let self interest, pre-judgment, or prejudice color or bias either *your observations* or the *report*.

(11) Be *sure* you know all about everything involved in the *test* except the thing or function being tested. That is, there should be only *one thing* involved in doubt at a time.

(12) *Never* introduce *two* unknown quantities into a test together for you certainly ought to know the effect of each before they are combined.

(13) *Always* give *complete* information as to the *methods* and *conditions* under which the tests were made; also *compile* the data in such a way that the one to *whom* it is submitted can comprehend it and thus extract conclusions without further explanation.

(14) If the last above mentioned is *not closely* observed, it is clear that *your competency* to draw the conclusion is what must be accepted and *not* the *report*. This *often* leaves the question where it was at the beginning.

(15) Where results *vary* materially tests should be stopped until the reason therefor is known. In any case, if these variations are inherent in the device, the reason should be *stated* as they obviously have to be dealt with in considering the *efficiency* of the device.

(16) Look for the cause of things and do *not mistake* effect for cause.

(17) Until *you* can destroy or recreate the effect *at will* you are not *sure* of its [illegible]

[illegible] up everything again so as to do this), otherwise it is plain you have *not* observed all of the foregoing.

[illegible] what it *should be*, find out why and don't *complete* the report *until this* is done. This should then *form a part of the* [illegible]

(20) Make *sure* that the test result con- [illegible] *why* it does not, before disturbing the apparatus being tested or the arrangements, unless by instruction.

(21) *Remember* that the *result recorder* of tests is very important, for it not only exhibits the *quality* of the de- [illegible] *THE DEVICE.*

(22) My definition of experiment is finding out what is unknown.

My definition of test is—finding out whether what is thought to be, really is.

(23) *Whenever* making an experiment, it is necessary to know *two* things before making it—(1st) that every condition involved in the experiment is normal. (2nd) that the device being tested is made according to the design and is in a commercially workmanship-like condition.

(24) When making either an *experiment* or a *test*, it is vitally essential that *all* the conditions involved in the experiment, such as apparatus, instruments, reliability of observers, etc., be known—the only unknown quantity being the device, or the result itself, for it should be plain that if there are two or more, it may be exceedingly difficult, if not impossible, to tell which of the two gives the result, or whether or not it was a composite result and thus, unless it was impossible for the combination ever to be changed, the result would be worse than valueless, for on the one hand it might result in the condemning of a satisfactory device, or on the other, in the assumption that the device was satisfactory when in reality it was not.

(25) It will be seen therefore that, in making an *experiment*, the *unknown* quantity is the *performance* of the device [illegible]

(26) When making a test all included in the foregoing paragraphs (23 and 24) must be insured, and in addition the *expected performance* of the device must be outlined. Thus it will be seen that the *unknown* quantity in a test is that of whether the device performs or operates as *outlined*, or expected, or not.

(27) Even when the best has been done both in men and mechanism in setting the stage for experiments or tests, the elements of reason and experience, that is to say, competency, still remain a very large factor in securing accuracy and trustworthiness of the report. Therefore, any act or evidence of mere perfunctoriness in either the work or report will condemn it in a degree, if not entirely.

(28) When unexpected results or evidences appear, the experiment or test should be stopped until the reason or cause is ascertained, which, it is self-evident, must be either in the instruments employed in the experiment or test—the device being experimented with or tested, or in the observations of the human end of the affair.

(29) The foregoing rules for making experiments and tests are essential if thoroughness and reliability are to be assured, and I judge all will agree that

without these two elements, experiments and tests are worse than valueless, for they may mislead.

By thoroughness is meant that all was done that should have been done.

By reliable is meant that the report is accurate and impersonal, that is scientific.

(30) *Of course* it is known by whoever is responsible for the report, and is therefore making the experiments or tests, whether a device is being tried, (a) to see what it will do under a set of known and *provided conditions,* or (b) whether the result or performance has been *devised* and *designed,* for, and a trial being made to ascertain whether or not it is realized; that is to say an *experiment* is to find out what a device will do, and here it is assumed that its qualities or the results are unknown; or a *test* of the device, in which case, its quality and results are supposed to be *known*—the test being made merely to determine whether or not the results expected are actually obtained. You will note a very broad distinction between these two and, therefore, it is imperative that you know before hand which of the two you are concerned with.

(31) Remember that until the foregoing epigrammatical rules *become second nature,* no one is qualified in full degree to make either experiments or tests.

(32) Also remember that even if you observe *all* these rules and others, you may still fail in *some degree,* but not in toto.

(33) Remember that *instructions* may cancel some of these rules.

(34) One of the chief intents of these suggestions or rules is that more thought be given to the experiments, or tests, *before* instead of *after* they are made.

(35) Do *not* think because you have these rules or this expression of principles in *your possession* that *you* are immune from making mistakes. It takes understanding as well as possession to make this information of value; in fact, without undertsanding, possession may do harm instead of good, as it may be wrongly applied. It is not knowledge itself that is valuable, but the intelligent application thereof. Information may be *given* but not *undertsanding,* and *understanding* is required to make information of any value or use to *you* as well as *others.*

(36) Most of those for whom this is intended will say that I have set before them a large task, but they should remember that the requirements are not of my making, they are *inherent* and *immutable*—all I have done is to point out part, at least, of what is required.

With these observations carefully in mind a degree of thoroughness in all kinds of work will become a kind of second nature to the earnest seeker after truth, which in time will be ap[illegible] all with whom he may come in contact.

Attacking New York Central Lines.

People familiar with the details of great railway systems are aware that many trunk lines are made up from small units that have been absorbed by consolidation, purchase or otherwise. This system of consolidation has been of decided public benefit and has been the means of cheapening and facilitating transportation, but the politicians are finding out that some of the consolidations violate the Sherman Anti Trust law and the indications are that a period of persecution is at hand.

The New York Central Lines, of which ex-Senator Chauncey M. Depew is chairman of the Board of Directors, appear to have been as indifferent to legal obstructions as any corporation that we are acquainted with. The New York Central Lines and Leased Lines have been formed from 33 companies, most of them still having operating staffs under control of the Central officials. Any movement by the United States Government that will dislocate the great system of railroads known as the New York Central Lines will involve disaster to many individuals. That such a move is probable may be inferred.

Senator Norris, of Nebraska, introduced a resolution concerning the New York Central holdings as follows:

Whereas, The New York Central & Hudson River Railroad Company, through its ownership of the stock of the Lake Shore & Michigan Southern Railway Company, forms a continuous line of railway from Chicago, through Buffalo, to New York City; and

Whereas, Said New York Central & Hudson River Railroad Company controls by lease the West Shore Railroad Company and the said Lake Shore & Michigan Southern Railway Company, owns the stock of the New York, Chicago & St. Louis Railroad Company (Nickel Plate), which together with the said West Shore Railroad Company, constitutes a railroad running parallel to the Lake Shore & Michigan Southern Railway Company and the New York Central & Hudson River Railroad Company from Chicago, through Buffalo, to New York City; and

Whereas, The New York Central & Hudson River Railroad Company owns the stock of the Michigan Central Railroad Company, a line of railway extending from Chicago to Buffalo; and

Whereas, Said New York Central & Hudson River Railroad Company owns the stock of the Western Transit Company and the Rutland Transit Company, constituting a water navigation line engaged in interstate commerce between Buffalo and Chicago and intermediate points; and

Whereas, This ownership results in a combination under one control of four competing lines of transportation between Chicago and Buffalo and two competing lines between Buffalo and New York City; and

Whereas, The said Lake Shore & Michigan Southern Railway Company, in addition to the ownership of the said New York, Chicago & St. Louis Railroad Company, owns all of the stock of the Toledo & Ohio Central Railway Company, of the Chicago, Indiana & Southern Railroad Company, of the Ohio Central Railway Company, and of the Jamestown, Franklin & Clearfield Railroad Company, and also owns more than 50 per cent. of the stock of the Pittsburgh & Lake Erie Railroad Company; and

Whereas, The said New York Central & Hudson River Railroad Company controls the Western Maryland Railroad Company, which, together with the said Pittsburgh & Lake Erie Railroad Company, constitutes another competing line between territory covered by the Lake Shore & Michigan Southern Railway Company and the New York, Chicago & St. Louis Railroad Company and the Atlantic seaboard; and

Whereas, The said New York Central & Hudson River Railroad Company is now taking the necessary steps to more completely consolidate all of the aforesaid railroads, together with others, under one ownership and control; therefore, be it

Resolved, by the Senate of the United States, That the Attorney General be, and he hereby is, directed to inform the Senate whether the various combinations of railroads above set forth are in violation of the Sherman anti-trust law or any other statute of the United States and whether the Department of Justice has in contemplation any action for the dissolution of said combination.

"To my mind," Senator Norris said today, "it is perfectly apparent that this combination, in all its branches, is in violation of the Sherman anti-trust law. The Supreme Court recently held that a combination between the Central Pacific and the Southern Pacific was in violation of law, and a decree was entered in the Supreme Court dissolving this combination, although, as a matter of fact, the railroads, for a large portion of the distance, are more than a thousand miles apart.

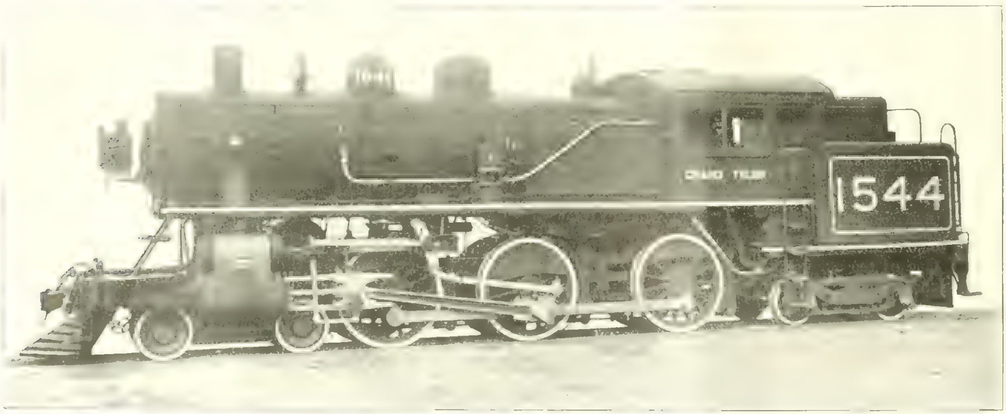
"In addition to the roads set out in the resolution, there are several other railroads owned by the New York Central, but I have only attempted to call attention to the most flagrant violations of the law. Right now the New York Central is engaged in the operation of bringing about a more complete consolidation of these roads and others than has existed in the past, and it seems to me that the time is ripe for action to be taken, not only to break up the combination that already exists, but to prevent further steps in the way of throttling competition."

Suburban Type of Locomotive for the Grand Trunk

Six Suburban type locomotives have recently been [illegible] the Grand Trunk Railway by the American Locomotive Company [illegible] reported on as filling the requirements of the service with a degree of fitness that is meeting with warm approval.

These locomotives have been put in service between Montreal and Vaudrieul, a distance of 24 miles, and between Montreal and St [illegible] distance of 37 miles. Where this kind of traffic is frequent, the Suburban type engine can be used to good advantage. Delays caused by turning the locomotive are eliminated as the Suburban type can run in either direction with equal advantage.

This traffic on the Grand Trunk Railway was formerly handled by 4-4-2 Su[illegible] type locomotives having 17x22 inch cylinders and a total weight of 128,-000 pounds. As this traffic increased [illegible] inch Moguls [illegible] Wheelers



[illegible] RAILWAY

were also used. New suburban cars have recently been placed in service which weigh 138,000 pounds as compared with 75,000 pounds weight for the older class of car. As it was also desired to increase the number of cars in a train, it became necessary to design a more pow-[illegible]

the traffic and the different types of engines used, influenced the railway officials in deciding on the Suburban type for the new power. These new engines are handling an average train of 7 cars. Trains of 5 cars were the average with former power.

[illegible]

feature is the combination of the Gaines combustion chamber and a Security brick arch. This combination secures a very [illegible] better combustion is obtained [illegible] end of the firebox is more fully utilized with a resulting increase in the generation of steam; and the amount of smoke is reduced to a minimum which is so important in this kind of service. The front truck is equalized with the drivers as it was not desired to have more than two systems of equalization. Other features are, a Schmidt superheater, outside steam pipes, self centering valve stem guide, extended piston rod, the improved throttle lever bracket which has also been applied on the Mikados for this road, long main driving box, and vanadium main frames.

The following are the general dimensions of these locomotives:

Track gauge, 4 ft. 8½ ins.

Fuel—Bituminous coal.

Cylinder, type—Piston valve; diameter 21 ins., stroke 26 ins.

Tractive power, simple—30,940 lbs.

Factor of adhesion, simple—4.7.

Wheel base driving 15 ft. 8 ins.; rigid, 15 ft. 8 ins.; total 38 ft. 11 ins.

Weight in working order 262,000 lbs.; on drivers, 146,000 lbs.; on trailers, 67,000 lbs.; on engine truck, 49,000 lbs.; engine, 262,000 lbs.

Boiler, type—Straight top radial stay; O. D. first ring, 71 9-16 ins.; working [illegible]

Firebox—Type, wide; length, 129 ins.; width, 75¼ ins.; thickness of crown, ⅜ in.; tube, ½ in.; sides, ⅜ in.; back, ⅜ in.; water space front, 5 ins.; sides 4½ ins.; back, 4½ ins.; depth (top of grate [illegible]

Crown staying—Radial.

Tubes—Material, cold drawn seamless steel; number, 191; diameter, 2 ins.

Flues—Material, seamless steel; num-[illegible]

Thickness tubes, .125; flues, No. 9 B. W.C.

Tube—Length, 11 ft. 10 ins.; spacing, ¾ ins.

Heating Surface—tubes and flues, 1604 sq. ft.; firebox, 173 sq. ft.; arch tubes, 31 sq. ft.; total, 1808 sq. ft.

Superheater surface, 347 sq. ft.

Grate area, 47 sq. ft.

Wheels—Driving diameter, outside tire, 63 ins.; center diameter, 56 ins.

Wheels—driving material, main, cast steel; others, cast steel; engine truck, diameter, 30½ ins.; kind, solid steel; trailing truck, diameter, 31 ins.; kind, solid steel.

Axles—driving journals, main 9½x20 ins.; other, 9½x12 ins.; engine truck journals, 6½x10½ ins.; trailing truck journals, 6x11 ins.

Boxes—Driving, main, cast steel; others, cast steel.

Brake—Driver, Westinghouse American; trailers, Westinghouse American; air signal, Westinghouse light; pump, 11 in. Westinghouse; reservoir, one, 30½x72 [illegible]

Engine truck, 4-wheeled center bearing.

Trailing truck, 4-wheeled center bear-[illegible]

Exhaust pipe, G. T. Standard; nozzles, 4⅝, 4¾ and 4⅞ ins.

Grate—Style, rocking bars G. T. Standard.

Piston—Rod diameter, 3¾ ins.; piston packing, Trojan.

Smoke stack—Diameter, 15 ins.; top above rail, 14 ft. 9-9-32 ins.

Tank—Style, waterbottom; capacity, 3500 U. S. gallons; fuel, 5 tons.

Valves—Type, piston; travel, 6 ins.; steam lap, 1 1-16 ins.; ex. lap cylinder 3-16 in.; setting, load 3-16 in.

Railroads in the South.

"The Lawyer and Banker and Southern Bench and Bar Review" publishes a scathing article on governmental interference in the railroads in the South for which we quote the following:

"Railroad construction in the South in the year 1914 showed the smallest mileage in the last half century. This is largely due to Congressional interference. It must be remembered that in Congress the South is in control. Through Congressional activity exerted in the wrong direction, the entire railroad industry of the country has suffered and the South has in consequence been paralyzed more than any other section of our land. This is a conscious loss which totals up an enormous figure.

"This loss comes at a time when it can not be borne—when the cotton crop has decreased, not in quantity or in quality, but in marketability; while important States have received another black eye in the adding of resinous products, by the Allies to the contraband list. Rosin is the binder of shrapnel shells, camphor is a constituent of smokeless powder, and turpentine is the only discovered basis for a synthetic substitute. These, with the depression of trade, make the burden heavy to bear. But persecution of the railroads, as the cheapest kind of politics, has added immeasurably to the paralysis of what once looked like promising development of Southern resources.

"What is at the bottom of all this? It is two-cent fare laws, mischievous meddling in the place of regulation, sacrificing broad interests to the selfish demands of shippers who demand rates bearing no relation to the value of the service performed. These things have frightened capital away. Real estate remains undeveloped, the industries which supply the railroads drift from bad to worse, and the last economic failure is seen in the fact that additions to taxes already oppressive yield a lower revenue to the respective States.

"There is an old fable of Aesop which Congress and the Southern Legislatures should ponder. It tells of the dispute between the Sun and the East Wind as to which could make the traveler remove his cloak. The wind only made him draw it closer around him. Prosperous railroads mean prosperous business, and a larger tax collection for public development from the greatest taxpayers in the country."

Persia, an Ancient Country, Building Railways.

Persia, one of the most celebrated of the ancient empires, is still a country of some importance covering as it does some 610,000 square miles and occupying the great plateau lying between the Tigris and the Indus. Persia has a very intelligent industrial population, but the prosperity of the country has been seriously retarded through want of transportation facilities. The highways are of the most inferior character and there are no railways of any importance, but the indications are that the serious want will be supplied in the near future.

In 1888 a railway five miles long was built by a Belgian company, but Russian influence stepped in to prevent further extension of that means of transportation. Ten years later the Russian government obtained a concession giving them entire control over railway construction and the privilege was used to stop all railway building. Lately the officials of the Czar have been stirred to a new policy and the construction of railways on a large scale is promised. With proper means of inland transportation in use Persia promises to become one of the most prosperous countries in the world.

The principal productions of Persia are elaborated metals, woolen fabrics, pearls, fruits, tobacco, gums, cereals and horses. The people have enjoyed many centuries of culture in skilled operations and they appear to have maintained the inheritance of skill and technical knowledge. The productions in metal arts consist largely of hammered ware or of designs chiseled or engraved in iron, brass, copper, silver and gold. The silken rugs of Persia lead the markets of the world.

The pleasures of the Persians are in the main refined. They have not many kinds of recreation. Conversation is one of their chief enjoyments. Although a large proportion of them can neither read nor write,we must call them an intellectual people.

They are natural linguists, and since their country is inhabited by many different races they are obliged to speak several different languages. It is not uncommon to find a man who scarcely knows his right hand from his left who can speak two or three languages fluently. To this number a man of any education whatever would add two or three more.

There is no caste among any of the races found in Persia. A son of Nasir-i-Din Shah's butler became his prime minister; a peasant girl once became the first favorite of this same king's anderun because she lifted her veil as the king was passing through her native village and her beauty appealed to the royal fancy.

But while there is no caste the Persians are in some ways great sticklers for etiquette. The Zi-i-Sultan, the oldest and most capable son of Nasir-i-Din, could not succeed his father on the throne because his mother was not of royal birth. All social functions, moreover, are attended with the most rigid ceremonies, and woe to the person who attempts to overstep the bounds which custom has prescribed for his rank.

The Persian would prefer to be let alone, but the rest of the world thinks otherwise.

Quitting the Parent Shop.

We frequently hear complaints made by concerns employing apprentices that there is a tendency among the young mechanic to quit the shop where they learned their trade as soon as their time is up. It seems to us that the influence which moves apprentices to go away from their parent shop is a tradition of European origin. In most European countries it is expected that a mechanic will become a "journeyman"—that is, a wanderer—as soon as he finishes his apprenticeship, and employers do not encourage young graduates for the trade to remain with the parent shop.

It is good for the graduates of a trade to go out and learn the practices of strange shops and factories, but it is better for them to remain where they are well off.

Railway Materials for Argentina.

Now that Germany, France and Belgium are in all likelihood to remain in the background for some years as far as furnishing railway material is concerned, large orders are likely to be placed in the United States and Canada, as the worn-out stock on the Argentine railways will have to be replaced if the railways are to be maintained in a state of efficiency. The Argentine railways extend to 21,000 miles. She produces more grain than Canada and has a larger foreign trade. The present is the time to commence preparing for the business that is bound to come.

Fortunate Erie Apprentices.

The Erie Railroad Company continue to maintain the technical schools for the education of apprentices in connection with five of their repair shops, viz.: Port Jervis, Susquehanna, Hornell, Meadville and Dunmore. The Erie apprentices enjoy greater privileges than the apprentices of any other industry we are acquainted with. They engage to serve four years apprenticeship, but every one who displays mechanical ability is after two years given journeyman's wages and required to perform journeyman's work.

Coal Deposits.

A new mineral called thorianite has been obtained from the residue of gem-washing in Ceylon. It carries over 70 per cent. of thorium dioxide, 7 per cent. of the cerium group, 12 per cent. of uranic dioxide, 2 per cent. of lead monoxide, and accessory weights of ferric oxide and silica.

Block Signaling on the Southern.

The Southern Railway has started work on the installation of electric automatic block signals in connection with the double track now being built between Pelham and Denim, N. C., 36 miles. Forty-three signal towers will be erected.

General Foremen's Department

Locating Eccentric Keyways Before Setting the Valves.

[illegible]

The problem of locating eccentric keyways before setting the valves comes up occasionally, or, like Banquo's ghost, "it will not down." Last September an excellent article on the subject from the clever hand of Mr. Lenwood Skellinger, of the Baltimore & Ohio Railroad, attracted wide attention, and has been much commented on, the consensus of opinion being that Mr. Skellinger's clever solution of the question contained calculations finer than are within the mental grasp of the average valve-setter, and could only be clearly followed by those advanced in the higher mathematics. However this may be, and with all due regard to Mr. Skellinger's marked ability, it may be said that he was not the first who had successfully set the eccentrics in their proper places before the wheels were placed under the engine.

As the locomotives increase in size, and the space between the frames remain the same, it is getting to be more and more difficult to adjust eccentrics to their proper places and key them on properly in the extremely limited space available, not speaking of the delay at a time when the engine is about finished, and an angry superintendent looking amazedly on, as if keys could be put into four eccentrics like dropping pennies into a subscription box. If, therefore, the keyways in the axle can be cut in advance and the eccentrics fastened in the exact position desired, a gain [illegible]

[illegible] Chicago & Northwestern the job has been done in advance for many years, but every railroad shop has not a foreman like Mr. Charles Markel, an accomplished machinist and inventor of continental reputation. [illegible] Mr. Skellinger's, and consists briefly in having a board 1½ by 10 inches, by about 5 feet long, with a half circle the size of the largest shaft, say 10 inches, cut in the [illegible] axle. As shown in the illustration, this clamp can be raised or lowered so as to bring the top of the board to the center of any size of axle. A small level is inserted at one end of the board, so that if the line from the center of the drivers to [illegible] for the proper incline for different classes of engines. The board should be clamped on the axle close against the eccentric, then put the main crank pin on the dead center, either forward or back, by plumbing the crank pin on the opposite side, then put the eccentric plumb on the shaft, either with the large part of the eccentric up or down, according to forward or back motion. This, of course, would bring the valve on the middle of the valve seat, then give the eccentric the proper angular advance towards the crank pin measured on top of the board which is the center of the axle, and mark the key-way.

The proper amount of advance depends

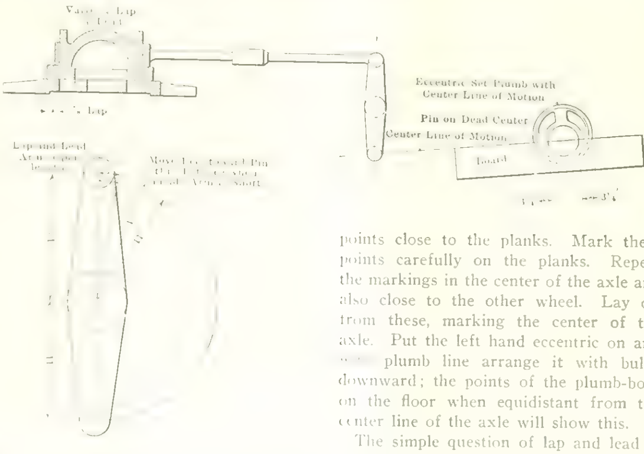


FIG. 1.

[illegible] amount of lead which is desired to be given. If the lap is ⅞ of an inch and it [illegible] we advance the eccentric 1 inch, provided both inside and outside rocker arms are the same length. If the arms of the rocker vary in length the proper allowance of variation must necessarily be made.

Another plan is practiced in some shops in keying on the eccentrics before the wheels are placed under the engine. It is this: Assuming that the rocker arms are equal in length, roll the wheels to a convenient point in the shop, where there is a good wooden floor between the rails and over a pit, then place a clean pair of pit-planks under the axle, and drive a couple of nails through the planks into the stringer, so that the planks cannot be moved. The next operation is to place the driving wheels, so that they will be correctly quartered with reference to the floor. Place the right crank pin on the top quarter, and drop a line with a plumb-bob on each end and near the pin or hang it over the pin. If the two lines are equidistant from the center of the axle then the wheel is so placed that the right crank pin is exactly on the top quarter, and the left crank pin is on the back quarter. The wheels should then be wedged in position by small nuts on the rails so that the wheels cannot roll.

Then drop the line with attached plumb-bobs over the axle near the wheel, and let the plumb-bobs hang down with points close to the planks. Mark these points carefully on the planks. Repeat the markings in the center of the axle and also close to the other wheel. Lay off from these, marking the center of the axle. Put the left hand eccentric on and [illegible] plumb line arrange it with bulge downward; the points of the plumb-bobs on the floor when equidistant from the center line of the axle will show this.

The simple question of lap and lead is readily determined. Suppose it is as formerly, 1 inch. In such a position the valve will be exactly 1 inch off its center, and if there is a rocker arm, we know that the left forward eccentric must follow the crank in the Stephenson valve motion. The left crank is on the back quarter, corresponding to the position of the piston on the left side. The eccentric is now to be moved with center line of bulge toward the left crank and as soon as the plumb-bobs show that their points have moved 1 inch from the points found when the bulge was exactly downward, secure the eccentric in that position, and mark off the keyway. Similar operations will bring the other eccentrics to their proper positions.

In conclusion it should be affirmed that these methods have all been successfully accomplished, but seldom on the first trial. As a rule, like all innovations, they are condemned in advance, and when a trial is granted to some earnest mechanic by

some doubtful superior officer, and the result falls short of perfection, as it generally will do, importance sits upon the dark brow of the man in authority; and the skilled artisan from whose cunning hands the ideal of perfection has not come at the first attempt, unless he is possessed of high courage, will walk in the valley of humiliation a long time, and wearily follow the beaten track; but if he is encouraged as he should be, and tries again, he will make new discoveries, and at the third or, perhaps, like Bruce's spider, at the seventh trial, new lights will break upon him and the hand of a master will come to him. All art without encouragement dies, and it is a peculiar fact that the most gifted and accomplished are usually the most modest. In railroad work, and more particularly in repair

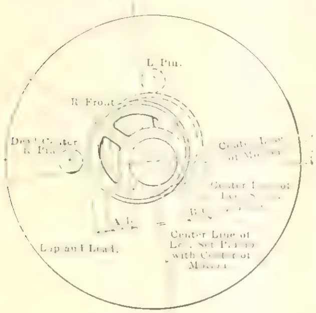


FIG. 2

work, it seems that there is rarely time for new experiments, and if a chance does come and failure follows, that is the end of it. This is particularly the case, as we have already stated in finishing the repairs of a locomotive; in fact, the repairs seem never to be completely finished, and weary hands are glad to drop the great machine, sometimes full of potential possibilities for disaster, and rarely in the complete degree of perfection that the skilled mechanic would wish.

Percentage of Eye Accidenst High.

In a recent report of the Industrial Commission of Wisconsin, they show that over 70 per cent. of all the injuries to workmen caused by chips, nails and other small objects affect the eyes. Out of a total of 346 cases reported, 32 men lost the sight of one of their eyes entirely, 217 had eyes injured, 75 suffered from lacerations, 7 from impaired sight and 15 from bruises. The causes of the above injuries were as follows: 283 were hit by chips, 14 by nails, 4 by stone from blasts, 3 by bursting water glasses and 42 by other small objects.

The commission further states that of the 70 per cent. it is safe to say that fully three-fourths of these eye injuries could be avoided by the wearing of goggles; and, in fact, within the past year many Wisconsin plants have adopted the use of goggles and as a result eye injuries have been almost entirely eliminated.

This is one of several items recently called to our attention by T. A. Willson & Co., Inc., Reading, Pa., who specialize in the manufacture of industrial protection glasses for workmen.

Coal Exports from United States.

The United States, which produces 40 per cent of the world's coal exports annually 27,500,000 tons, or about 5 per cent. of the output of last year, the total export in the fiscal year being valued at $86,000,000. Exports of domestic coal have doubled during the last decade, having increased from 8,482,867 long tons in 1904 to 19,664,080 tons in 1914, the latter total being with one exception (1913) the the largest on record.

Mineral Oil.

We all know in a vague way that the production and use of mineral oil in the United States are very high but few people realize the extent of the industry. The number and uses of oil products are innumerable, as the activity of the primary industry is indicated by the statement that for the latest months reported, an average of one well in every seventeen minutes was completed in the fields east of the Rocky Mountains.

Influence of Cleanliness.

Cleanliness is said to be almost as desirable as godliness and in the minds of many people cleanliness is the most desirable of habits. Cleanliness is not a natural habit and it takes years of training and example to lead former people away from the practice of stewing themselves in filth.

Outside of the uncivilized tribes, all the people of America are inclined to be cleanly, but in other parts of the world filth is the familiar condition of nearly all the people. Surprise is sometimes experienced that the dreadful plagues that used to cut down the population of the world are no longer in evidence and the explanation is that cleanliness has stopped those ravages.

Some time ago Professor Sedgwick, of the Massachusetts Institute of Technology, delivered a lecture on the Rise and Significance of the Public Health Movement in the course of which he made some very striking statements.

Mr. Sedgwick began by sketching the sanitary condition of England in the thirteenth century. The inhabitants were, he asserted, men very little removed from the beavers which at that time built their dams in the Lincolnshire Fens and other waste places. In London, which was already a populous city, the streets were made of loam covered with rushes, which harbored all kinds of filth, and were only removed every twenty years.

The houses, made of wood and plaster and thatched with straw, had dirt floors strewed with rushes, which were swept into the street when they had become so encumbered with refuse as to render their further presence in the dwellings unbearable.

The people lived almost entirely on meat, mostly salt, and fruit and vegetables were practically unknown. Bathing was rare and sanitation was not thought of. Dirt prevailed everywhere, and bred smallpox, typhus fever, and all kinds of malignant skin disease that were called leprosy by the quack doctors of the period.

There were no physicians for the poor. The monks went from house to house to smooth the path of the dying to the next world, not to bring them back to this. Life was hard for all in those days, from the peasant crouching in his hut to the lord of the bare, uncomfortable castle near by. The people did not burn lights at night because there was nothing to see.

Even in the much-belauded sixteenth century the inhabitants of England, according to Prof. Sedgwick, had made very little progress since the time of Julius Caesar. Filth still reigned supreme, and the odors from the Fleet ditch, that flowed through London, were so powerful that they overcame the perfumes of the incense burnt in the city churches near its banks.

There was no ventilation either in the houses ashore or the ships at sea, and the death rate was 1 in 23. The streets were unlit and impassable in wet weather and were infested by highwaymen, while the rivers and coasts swarmed with pirates.

After the Great Plague and the Fire of London in Charles II.'s reign, officers were appointed to look after the public health and see that the streets were made wider and the houses were more substantially built. These were the first health officials to be appointed, but they did not remain in office long.

The air was so bad in the Parliament House at Westminster that Sir Christopher Wren was called in to devise a scheme for ventilating it. But he was thwarted every day by the scrubwoman, who had the cleaning of the House under her charge, as she considered fresh air to be dangerous to health.

Vanadium Steel.

The American Vanadium Company announces that vanadium steel is being used for the first time in a purchase of new engines by the Southern Pacific: this in 20 Mikado locomotives recently delivered to the company for use on the Sacramento Division, the manufacturers being the Lima Locomotive Corporation.

Catechism of Railroad Operation

[illegible]

Third Year's Examination.

[illegible] January, 1915.

Q. 155.—How would you handle a hot eccentric?

A.—See that all oil holes are clean and that the lubrication is getting to the bearing. If the strap is too tight on cam would loosen nuts on strap bolts and put in liners enough to make it free, then tighten the strap bolts. If the strap is too loose on the cam, causing it to pound hot, would loosen strap bolts and remove liners enough to make strap fit the cam.

Q. 156.—Would you use water on a hot eccentric?

A.—No.

Q. 157.—Why would you not use water to cool a hot eccentric?

A.—Because the strap is so much lighter than the cam that it would cool off faster than the cam and contract and tighten on cam until it bursted, and the cam would contract faster than the axle, causing the cam to burst.

Q. 158.—How would you handle a hot driving box to cool it down and prevent cutting the bearing?

A.—Would be sure that the bearing was getting the lubrication; if it did not cool down then, I would run the wheel up on a wedge and block on top of frame under the spring saddle, or under the ends of the arch equalizer to relieve the box of weight.

Q. 159.—Is it good practice to use water [illegible]?

A.—No. It causes crystallization and weakens the metal, eventuallly resulting in a break.

Q. 160.—What will cause crystallization and weakening of metals used in bearings, besides sudden expansion and contraction?

[illegible] the metal or a constant hammering of the metal while it is cold will cause the molecules to crystallize, forming what we generally [illegible] as the grains of the metal become coarser the metal grows weaker at that point.

Note.—This effect is clearly noticeable [illegible] broken ends will show that the pin has been gradually separating until only a small portion of the pin is intact, then a sudden strain separates that portion so the break shows just how much of the metal was holding before the break.

Note.—When rod brasses pound on the pins, the hammer blow which the pin receives, when the piston starts backward and forward in the cylinder taking up the lost motion in the brasses, causes the pin to bend at point in line with the face of the wheel, starting the weakening of the pin at that point through crystallization.

Q. 161.—What is the effect of leaky steam pipes or exhaust joints?

A.—It prevents forming a vacuum in the front end and stops the draught on the fire, causing the fire to burn a dull red color and engine will not steam.

Q. 162.—How would you test for leaky steam pipes?

A.—Place the reverse lever in the center of the quadrant, open the front end door, apply the brake, pull the throttle wide open to admit full steam pressure to the pipes, and with a lighted torch try around the joints for leaks—the leak will be shown by the flare of the flame.

Note.—The reason for opening the throttle wide is that the great pressure inside the pipe has a tendency to straighen it out and will develop a leak if one exists, and a lighted torch is the only sure way to locate the leak, because the escaping steam is not visible, and the old idea that the cinders will be blown away from the leaking joint is not reliable for the reason that chemical action takes place in cinders, causing them to form a porous mass solidly knitted together through which the steam will pass without moving the cinders.

Q. 163.—How would you test for leaky exhaust joint?

A.—The best way is to get the engine [illegible] the front end door and have the fireman start the engine moving; then apply the brake and open the throttle wide; take a lighted torch and try around the nozzle [illegible] the escaping steam will blow the flame of the torch and locate leak.

Another way: Place the engine on the quarter (top or bottom), open the front end door, have the fireman set the brake, open the throttle and move the reverse lever back and forth from corner to corner of the rack, take the lighted torch and try the joint on that side of the exhaust for the leak; place the engine on the quarter on the other side and test it in the same manner.

Note.—It is necessary to get a strong exhaust from each side to locate the defective joint; the base of the nozzle is divided into two openings by a partition which comes over the joint between saddle castings, therefore the reason for moving the engine to the quarter on each side for the test.

Note.—Another way to test for leaky nozzle joint is to place the engine on the top or bottom eighths; having the front end door open, set the brake, open the throttle, and move the reverse lever from corner to corner of the rack, trying for the leak around joint with lighted torch; in this way both sides may be tested without moving the engine, but it is not very reliable, because the exhaust will not be strong.

The best way to test is with the engine moving slowly with brake set and throttle wide open, where it is possible to do it that way, and the next best way is to place the engine on the quarter.

Q. 164.—What would cause you to test for leaky steam pipes or exhaust joint?

A.—The fire dying down and burning a blood red color and the exhaust not working the fire as it should when you begin to work steam, and the engine not steaming while working steam, but the fire burns brightly and engine steams as soon as throttle is closed. Sometimes the blow may be heard when the firebox door is opened.

Note.—When the air pump has an independent exhaust in the front end it gets disconnected or broken off, and it will affect the fire the same as the leaky steam pipes or exaust joint, only the leaky air pump exhaust will affect the fire and steaming of the engine all of the time as long as the air pump is working, while the leaky steam pipe joint or nozzle joint will only affect the fire when working steam.

Q. 165.—How would you test for pounds in main driving box?

A.—Place the engine on top quarter on side you desire to test, have the fireman open throttle, and move reverse lever from corner to corner of rack; watch movement of box to locate pound.

Q. 166.—Why do you place engine on top quarter on side you desire to test for pounds in driving box?

A.—To get the power applied as near as possible to the point you desire to move.

Note.—With pin on top quarter, all of the lost motion in box will be taken up before there is any liability of the wheel slipping.

Q. 167.—What are the principal causes for pounds in main driving box?

A.—Loose or broken pedestal binder, improperly lined shoe or wedge, wedge loose or down on binder, journal badly worn out of round or small, brass badly worn too large for journal, driving box brass broken, driving box broken.

Q. 168.—What other causes for pounds have we besides those affecting the driving boxes?

A.—Loose or lost cylinder key, loose follower bolts, piston head loose on piston rod, cylinder bushing short and loose in cylinder, piston rod loose in crosshead, lost motion between crosshead and guides, wrist pin loose in crosshead, rod brasses too large for driving pins, rod brasses loose in strap, knuckle pins or their bushings badly worn, engine frame broken and main rods keyed too long or too short so that piston head strikes cylinder head.

Q. 169.—Are all wedges alike in the manner of adjustment? How do they differ?

A.—No. Some are forced up by having the wedge bolt screwed through the binders, others have the wedge bolt passed through hole in binder, and have to be pried or pinched up and are secured and held in place with nuts on wedge bolt on top of binder.

Questions Answered

TRACTIVE POWER AND WEIGHT ON DRIVERS

W. D. K., Del Rio, Tex., writes: Please furnish me with the formula used in determining the drawbar pull of a 2-6-6-2 Mallet compound, both with and without a superheater of the following dimensions: High pressure cylinders, 21½ by 30 ins.; low pressure cylinders, 33 by 30 ins.; driving wheels, 57 ins., and steam pressure, 200 lbs. Would also like your opinion as to the weight necessary on the drivers of this engine to give it a reliable factor of adhesion. Also the necessary weight on the drivers on a simple engine with cylinders 26 by 28 ins., wheels 63 ins. in diameter and pressure 200 lbs. A.—The formula for a Mallet compound locomotive is $T = \frac{C^2 \times S \times 1.2\ P}{D}$, in which

T = rated tractive force in pounds.

C = diameter of high pressure cylinder in inches.

S = stroke of piston in inches.

P = boiler pressure in pounds.

D = diameter of driving wheels in inches.

Hence 21½ × 21½ = 462 × 30 = 13,867½ × 240 = 3,328,200 ÷ 57 = 58,390 = tractive power in pounds. Assuming 4.5 as an average factor of adhesion, the weight of the engine would be 315,000 lbs., of which five-sixths, 262,000 lbs., would be sustained by the drivers.

In the case of a simple engine the formula varies in the factor of the pressure which is usually rated at 85 per cent. of the boiler pressure. In the simple engine referred to the tractive power would be approximately 51,000 lbs., with a corresponding weight of the engine amounting to 250,000 lbs., of which about 209,000 lbs. would be on the drivers.

In regard to the use of superheated steam it may be briefly stated that the object is to reduce the loss caused by condensation. This is accomplished by raising the steam temperature to such a point that condensation is, to a large extent, avoided. Furthermore, since the volume per pound of superheated steam is greater than that of saturated steam at the same pressure, there is a gain in efficiency, because each pound of water evaporated forms a larger volume of steam, and therefore fewer pounds of steam are required to fill the cylinders.

The formula for calculating the tractive power of a locomotive equipped with a superheating appliance is the same as that of an engine not so equipped.

SATURATED AND SUPERHEATED LOCOMOTIVES.

E. S., Frankfort, Ind., writes: A consolidation four-wheel truck engine with cylinders 21 by 28 inches, steam pressure 200 pounds, and tractive force of 36,600 pounds—how much greater will the efficiency of this engine be if it were using superheated steam; and is weight of engine, 94 tons, enough to allow for a cylinder 24 by 28 inches? A.—The amount of increased efficiency will, under certain conditions, amount to at least 25 per cent. By efficiency it must not be supposed that the engine will start or haul a heavier load. The addition of heat to the steam does not increase the mean effective pressure in the cylinder. The pressure against the piston is the same with superheated steam as with saturated steam, and consequently the superheater locomotive will not start any heavier train than will a saturated locomotive of the same dimensions. It will, however, pull the same train at a higher speed. The superheater locomotive can be operated at longer cut-offs, thereby developing higher speeds with the same tonnage. The saving is in fuel and water; that is, a larger volume of steam may be generated and maintained with less fuel burned and less water evaporated. The weight specified, 94 tons, is not enough to allow of cylinders of the increased size referred to. If the driving wheels are the same, the weight would require to be about 112 tons.

THROTTLE VALVE AND VALVE GEAR.

T. M., Havre, Mont., asks: (1) How is the angularity of the main rod overcome with the Walschaerts valve gear? (2) How much and how would allowance be made for expansion when grinding a throttle valve? A.—(1) The angular advance of the main rod has little or no effect on the valves of an engine equipped with the Walschaerts valve gear. The eccentric being set at right angles to the main crank, the position of the valve in relation to the piston is maintained sufficiently correct at all points for all practical purposes. In an engine equipped with the Stephenson, or shifting link gear, the situation is vastly different. The two eccentrics are set 1 inch, more or less, removed from the right angle, and the suspension pin on the link must be adjusted to suit the distortion. (2) The allowance for expansion in grinding a throttle valve depends on the difference of the area of the two joints and the consequent variation in the areas when heated. The common practice is to continue grinding the upper or larger joint for a brief period after both joints are equal. Some mechanics use a small piece of silk paper in the upper joint after drying the joints; others trust to their fine sense of feeling a slight shake in the upper joint. It is largely a matter of experience and observation.

OUTSIDE AND INSIDE LAP AND INSIDE CLEARANCE.

A. D., Jacksonville, Fla., asks: What is the exact meaning of the terms "outside lap" and "insidelap," and "inside clearance"? A.—"Outside lap" refers to that portion of the valve used in admitting steam to the cylinder, which overlaps the steam ports when the valve rests centrally on the valve seat. "Inside lap," which is sometimes called exhaust lap, refers to that portion of the valve which overlaps the two bridges of the valve seat, when the valve is on the center of the seat. "Inside clearance," which is sometimes called negative exhaust lap, inside lead or exhaust lead, does not refer to any portion of the valve, but is the space between the inside edges of the exhaust arch and the bridges when the valve stands central on the valve seat. The term refers to the amount of each side.

PRONUNCIATION.

W. T. H., Galveston, Texas, writes: It would be gratifying to have the correct pronunciation of the following words: Mallet, Walschaerts, Ragonnet. I have heard all of these words pronounced in several different ways and would like to settle this question in my mind. A.—Mallet is pronounced Malay; Walschaerts, Walsherts; Ragonnet, Ragonay.

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Future Welfare of the United States Railroads.

The [illegible] welfare of the railway system of the United States is largely in the [illegible] and what will he do? Will he crowd the railway owner so hard that the latter cannot produce the increasing amount of transportation needed for the free flow of the com[illegible] Then what? The railway user will have sev[illegible] He can have a less rigid system of regulation and government red tape and encourage the railway [illegible] the great laws of supply and demand, competition and the natural desire of the owner to manage his business in such a [illegible] the hope of profit, which is the main incentive of all business. Or, he can take over the ownership and management of the railways and become responsible for their operation and for the money needed for additions and betterments to existing properties, and for the building of new ones. In the present state of politics in this country, such a plan is almost terrifying in its possibilities, because the government has not shown that it can do work of this character as efficiently and economically as private individuals can. Government ownership, management and development of the railways would become a matter for the politicians to trade upon. Just recently, in Austria, there has been considerable discussion because the railways were taken over by the state on the theory that better service and lower rates would be given to the public. Now there is agitation to put them back into private hands, for, instead of proving profitable, there is a heavy annual deficit, which the general taxpayer has to make up. The service has deteriorated and railway expansion has ceased.

Or, he can continue the present system of rigid governmental control and supervision, and interference with the judgment and management of the owner, which is rapidly having a deadening and discouraging effect on the development of the business, and is preventing those additions and improvements so much needed in a growing country like the United States. Or, he can continue the present system of government regulation and control, but guarantee to the railway owner some minimum return upon his investment, so he will be willing to put money into the business. Such a plan, however, means that the non-user of the railway will be taxed for the benefit of the user.

To our mind the first course, of more commercial freedom, is by far the better for a growing and expanding country like the United States. We have not yet reached the state of perfection, politically or socially, where government ownership and bureaucratic management of the large, complicated and delicately adjusted railway system of the country will be a success. Putting a government uniform on a railway employee does not at once endow him with a new kind of intelligence and supernatural powers, and it will reduce his feeling of responsibility.

Carnegie and Rockefeller on the Grill.

The United States Commission on Industrial Relations is a sort of inquisition body whose purpose seems to be the harassing of people who have made money. It has been holding meetings in New York lately, and among the prominent people who have passed over its grill were Andrew Carnegie and John D. Rockefeller.

The [illegible] of the Commission [illegible] Industrial Relations has been to indicate that rich people have secured their wealth by oppression of hard working laborers who have been kept in penury and given only wages sufficient to keep them alive. Messrs. Carnegie and Rockefeller are reputed to be the richest men in America and consequently the greatest offenders from the Industrial Relations Socialistic standpoint, so no efforts were spared to uncover the iniquities of the money makers.

To the disgust of the inquisition it was shown that both Carnegie and Rockefeller had donated a vast share of their wealth to various lines of benevolence for the promotion of education, comfort and well being of the people. Mr. Carnegie has given away $324,657,399 and Mr. Rockefeller $250,000,000.

The vast accumulation of wealth thus represented was made while the principles were treating the workers with laudable generosity. The testimony of both men was gripping in its appeal and the audience of about 500 men and women, made up principally of Socialists, students of sociology, and labor sympathizers, enjoyed the drama hugely.

Mr. Carnegie was the most remarkable witness that had yet appeared before the commission. Captivating the commission, as well as the audience, by the sheer force of his infectious geniality, he was allowed to tell his story in his own way, and had the crowd in roars of laughter, without any effort being made to restrain him. With an appealing sweep of his arms, as if he wanted to include the whole world in his philosophy of benevolence, the Laird of Skibo beamed as he told how his associates fondly called him "Andy," and how he wanted the poor and distressed to share in his happiness.

On leaving the stand Mr. Carnegie said he had never enjoyed himself so much in his life before, and his audience believed him. When he took the stand the ironmaster was asked by Chairman Walsh what his business was.

"To do as much good in the world as I can," the witness replied, with a smile. "I have retired from business."

Mr. Rockefeller was questioned along the lines of his Foundation. He said the sole motive underlying all his philanthropies was a desire to devote a part of his fortune to the service of his fellowmen. He regarded the restrictions placed abount the Foundation by the Legislature as an entirely sufficient guarantee against serious abuse of the funds.

The witness thought the stockholders of any corporation were responsible for the choice of the best men as Directors, and that the Directors ultimately were responsible for the general conduct of the business. He stated his belief in the right of all men, workers and those engaged in business, to organize with the

proper limitations in respect to safeguarding the interests of the public."

The best way to help the laboring man was to give him steady work and fair wages, Mr. Rockefeller said. That was better than all charity. He said he would be very happy to see all laborers share in some substantial way in the profits of their employers, and thought that, like all stockholders, they should be represented in the Board of Directors.

Mr. Taft Says the People Are Treating Railroads Unjustly.

Past President William Howard Taft ought to know as well as any living man when justice or the opposite treatment is accorded to railway property and he has recently raised his voice in favor of fair play. Speaking before the Athletic Club of New York, Mr. Taft said:

"The greatest sign of the times is the advance in mechanics, in which labor-saving devices with capital have multiplied production many fold. Home comforts never before were so nearly universal. The average workingman today enjoys more conveniences and luxuries than Queen Elizabeth did. The gap between rich and poor has steadily narrowed until now it is as nothing compared with the yawning breach of two or three centuries ago.

"But with this progress new evils have arisen which require new remedies, and they are all political. The politicians work while the rest of us sleep. We always will have bosses and machines.

"The railroads were found violating the law, and the Interstate Commerce Law was passed in 1887. The railroads laughed at it, and they kept laughing, but in diminishing degree, until the amendment of 1910 was passed. Now you don't find a railroad defying the people. Likewise, the anti-trust law of 1890 was laughed at by the corporations at first. Today business men consult lawyers almost daily to find out if they are violating the law.

"It has been a great reform. You don't hear of a corporation in politics now. If you do, the candidate with the corporation stamp of approval is a gone goose. So, too, identification with a machine beats almost any nominee.

"But this momentum of reform has gone over the line, and is now of a nagging character. Today the people are not giving the railroads their just rights."

Superheated and Saturated Steam.

From the letters that come to this office asking questions about steam superheaters we believe the impression prevails that superheated steam will exert more power than saturated steam per unit of pressure. The practice of superheating steam has been the most valuable and profitable improvement effected on the operation of the steam engine since Watt's time, but the cause of its advantages are by no means clearly understood. Owing to the metal of an engine's cylinders being colder than the entering steam there happen to be serious losses from cylinder condensation. Saturated steam is always at the dew point and the least loss of heat lets the steam turn into water. Superheated steam contains considerable more heat than is necessary to keep the steam vaporized so that a small loss of heat does not cause condensation of the steam. That is the secret of economy with superheat.

Given an engine using superheated steam and another using saturated steam of a certain mean effective, both engines will start the same weight of train.

Locomotive Inspection Bill.

A bill has been read in both houses of Congress twice and referred to the committee on interstate commerce, which if it becomes enacted into law after a third reading, will be the most important measure affecting the supervision of locomotives ever established in any country.

The following are verbatim copies of sections 2, 3 and 4 of the bill:

Sec. 2. That the chief inspector and the two assistant chief inspectors, together with all the district inspectors, appointed under the act of February seventeenth, nineteen hundred and eleven, shall inspect and shall have the same powers and duties with respect to all the parts and appurtenances of the locomotive and tender that they now have with respect to the boiler of a locomotive and the appurtenances thereof, and the said act of February seventeenth, nineteen hundred and eleven, shall apply to and include the entire locomotive and tender and all their parts with the same force and effect as it now applies to locomotive boilers and their appurtenances. That upon the passage of this act all inspectors and applicants for the position of inspectors shall be examined touching their qualifications and fitness with respect to the additional duties imposed by this act.

Sec. 3. That nothing in this act shall be held to alter, amend, change repeal or modify any other act of congress that the said act of February seventeenth, nineteen hundred and eleven, to which reference is herein specifically made or any order of the Interstate Commerce Commission promulgated under the safety appliance act of March second, eighteen hundred and ninety-three, and supplemental acts, except that for a violation of the act of February seventeenth, nineteen hundred and eleven, as hereby amended, or of any rule or regulation made under its provisions, or of any lawful order of any inspector acting thereunder, the offender shall be subject to prosecution by the United States for a penalty under said act, as hereby amended, only: Provided, That the passage of this act shall not affect any suit pending or offense committed prior to the passage hereof.

Sec. 4. That this act shall take effect six months after its passage, except as otherwise herein provided.

Minor Boiler Accidents.

An impression prevails that the only serious accident that can happen to a steam boiler is an explosion in which the boiler is rent in pieces, but we have information that minor accidents cause greater personal suffering than real explosions.

In the course of a most interesting talk given at the Traveling Engineers' convention by Mr. Frank McManamy, chief of the United States Boiler Inspection Bureau, he said: Injector and injector connections: During 1912 there were 47 accidents with 48 injured. During 1913 there were 28 accidents with 28 injured. During 1914 there were 27 accidents with 27 persons injured.

Injector steam pipe failures: During 1912 there were 31 failures with 38 injured. During 1913 there were 36 accidents with 47 persons injured. During 1914 there were 14 accidents and 17 persons injured. This is a subject that the Railway Master Mechanics' Association are wrestling with in hopes of making injector connections safer.

There are many other so-called minor boiler accidents that inflict a toll of death and suffering on many persons, but each accident being of small account the aggregate is overlooked.

Fighting the Full Crew Law.

An appeal is to be made to the public by the thirteen railroads operating in Pennsylvania, New Jersey and New York for aid in having the Full Crew laws recently enacted in those commonwealths repealed. It is believed by the railroad officials that with the aid of the voters they can have repeal action taken by the Legislature.

The railroads have organized a committee to take charge of the work. R. L. O'Donnel, general superintendent of the Pennsylvania Railroad Company, is the chairman, and other members are J. H. Ewing, Philadelphia and Reading; F. Hartenstein, Lehigh Valley; Robert Finney, Baltimore and Ohio, and J. S. Fisher, New York Central.

Statements are being prepared by the railroads and will be given the widest sort of publicity within a few days.

The railroads say that in no sense will they war upon their trainmen. The full crew law compels employment on thou-

sands of passenger and freight trains of extra men whose services are not required, forces waste of not less than $1,500,000 a year in Pennsylvania alone, they declare. It means in all such cases employment without service, the railroad explains.

The New Era for Railroads.

[illegible] most exhaustive article contributed to the New York *Times* by Mr. Daniel Willard, president of the Baltimore & Ohio Railroad. He opens by explaining that the attitude of the *Times* on the 5 per cent. rate case had moved him to write the letter discussing the condition of railroads as a separate interest and the almost unanimous support of the press in favor of liberal treatment of the railroads because it has become recognized that our country cannot prosper when any large portion of the people or its business interests is unprosperous and this principle applies with very great force when the particular interest in mind is one which, because of its nature, plays a part in our domestic and political economy second only in importance to agriculture. It is not overstating the case to say that in importance agriculture and transportation might properly be placed upon a parity, because in only a very small degree do the people in any part of our country depend for their sustenance and needs upon the products of their immediate vicinity, and it is only because of efficient and adequate transportation facilities that they can depend, and do depend, with absolute confidence, upon regions far remote for their flour, meat, and other necessities.

Referring to some of the difficulties encountered by the commission in trying to treat railroad interests fairly, Mr. Willard said: The commission clearly recognized [illegible] concerning the general railroad situation, and specifically stated that it was the duty and the purpose of the commission to assist so far as it properly might in the [illegible] In furtherance of that thought the commis[illegible] might be looked for, and if our political structure had been developed along the lines that were later on followed in the Dominion of Canada—that is to say, if the [illegible] except as limited by special restrictions, [illegible] it would be possible, I believe, with the assistance and support of the Federal Commission to work out without unreasonable delay a solution of the railroad problem along the lines suggested by the Federal Commission. It should be remembered, however, that each one of our forty-nine States, or, more specifically, each one of [illegible] known as official classification territory, has its own policy concerning the regulation of railroads. In some of the States it is not possible to advance local freight rates, for instance, without the consent of the Railroad Commission in that State, and in many of the States there are laws limiting passenger fares generally to two cents per mile, although it was very clearly shown by the able counsel retained by the Interstate Commerce Commission to assist it in the development of the rate case that a two-cent passenger rate was clearly unremunerative under most circumstances.

In order, therefore, that the policy outlined by the Interstate Commerce Commission in the Eastern rate case, and which I believe is a broad and constructive one in its possibilities, may be given effect and that the railroads may without undue delay obtain the relief proposed, it will be necessary to have also the friendly and affirmative co-operation of the several States, and this, in view of the searching and prolonged investigation of the Federal Commission into the whole subject, I think we may fairly expect to be forthcoming. If this is done, I believe the future outlook for the railroads is distinctly more promising than it has been at any time during the last decade.

Engine Power and Train Resistance.

It is highly important that railway companies should be able to decide how much of a train the various locomotives can pull and accordingly much time and attention have been devoted to finding out the amount of locomotive tractive powered train resistances under various conditions of operating. The tractive power of engines can easily be calculated, but finding the amount of resistance of the trains they are handling is a much more difficult problem. The various scientists who have labored on the problem of train resistance have nearly always tried to establish a formula of train resistance. When this formula or rule was carefully investigated it was generally found applicable only to the trains of one railway or even to one division.

At the 1914 convention of the American Railway Master Mechanics' Association a voluminous report was presented on Train Resistance and Tonnage Rating, which was full of rules, tables and formulae, but there is nothing in the report which a railway superintendent could use for instructing yard masters and others how the various locomotives should be loaded. There are figures showing the train resistance found on certain railroads, but they are not of general application. In fact, the resistance of a train is a quantity difficult to determine with accuracy. Conditions of lubrication, weather, condition of equipment, conditions of curves and track all count and they are rarely uniform. Then the wind resistance is an uncertain quantity, depending greatly upon how the wind strikes the cars.

Until about 1885 American railway officials were contented to use what was known the Clark formula for resistance of all kinds of trains and its was far too high. The formula is,

$$\frac{V^2}{171} + 8 = R$$

That is square the velocity in miles per hour divide by 171 and add 8 pounds per ton for the constant resistance. By degrees railroad men came to understand that this rule gave too much resistance and they substituted 6 for 8 as the constant resistance, but that was still too high. There was nothing to indicate that the train resistance increased in the square of the speed in mile.

In 1885 Angus Sinclair, who had enjoyed long experience as a locomotive engineer and was persuaded that the rules for train resistance were worthless, made a series of tests with freight trains on the Burlington, Cedar Rapids & Northern Railway which proved that the accepted rules regarding train resistance were worthless. He met with so much variety in the resistance of the different trains that he did not try to establish any fixed rule, holding as he did that it was necessary to investigate the resistance of every individual train.

In 1892 Angus Sinclair made a series of tests of locomotives pulling the Empire State Express to ascertain as accurately as possible the power required to pull the train at various speeds. In one of these runs a speed of 70 miles an hour was maintained for several miles and five indicator diagrams were taken when the locomotive was doing the work of maintaining the speed without loss or gain. The power developed indicated that the entire resistance of engine and train was 17.6 pounds per ton.

Arthur M. Wellington, a well known civil engineer who had devoted much time and exhaustive experiments on train resistances, remarked concerning Mr. Sinclair's test:

"The observations are among the most important evidences on record of the actual resistance of trains at high speeds. Perhaps we might even go farther and say that they are the most important, especially as they are reasonably consistent with the mean of the few other records which have been obtained for speeds of from 50 to 75 miles an hour, while presumably far more trustworthy and decisive than any of those prior records. As such they are a real contribution to technical knowledge."

After giving the leading particulars about the route, the train, the speed and the resistance recorded, Mr. Wellington made comparison of the data with those of a famous run made by Mr. William Stroudley on the London, Brighton & South Coast Railway; also with figures of train resistance found by Mr. P. M.

Dudley with dynamometer car, and declared that Sinclair's figures had established figures worth being accepted as authority.

The various tests that have been made on other railroads since Mr. Sinclair made the tests of the Empire State Express indicate that his rule of resistance for fast passenger trains are entirely reliable. That rule does not, however, apply to freight trains.

Many railroad companies are now using dynamometer cars that record with accuracy the resistance of trains. We enjoyed the privilege at one time of spending considerable time in the dynamometer car operated by the Chicago, Burlington & Quincy Railroad, the greater part of its work having been done on freight trains. From notes taken on that car we learn that one train of loaded freight cars, weighing 940 tons, gave an average resistance of 5½ pounds per ton when running 20 miles an hour. A train of empty freight cars weighing 340 tons showed a resistance of 12 pounds per ton when running on a level track at 20 miles an hour. The records for resistance of passenger trains as shown by the dynameter cars agree substantially by Sinclair's tests of the Empire State Express.

There is good reason for believing that the heavier the cars in a train are loaded, the smaller is the ton resistance, just as the case cited of loaded and empty cars. A particularly heavy train of freight cars on the New York, weighing with engine and tender 3,428 tons, gave resistance of only 4 pounds to the ton. The records of trains handled by the newest form of heavy engines when loaded close to their capacity seldom show a greater resistance than 4 pounds per ton at 20 miles an hour, when pulled over a straight track on a calm day.

A good illustration of the low rate of tonnage resistance in a particularly heavy train was found in a train hauled over a division of the Erie Railroad to test the hauling capacity of a new centipede locomotive. The train of 640 cars weighed 45,000 tons and the average train resistance on a level track was 3 pounds to the ton.

When officials are considering the elements that go to increase train resistance, too little attention, as a rule, is bestowed upon the resistance due to irregularities of track. When tracks are so defective that they fail to maintain the wheels revolving in parallel planes, the flanges of some of the wheels will keep grinding themselves on the rails greatly increasing the resistance to motion. All these causes that make a train hard to pull must be taken into consideration when the tractive power of locomotives is under consideration, and many of these causes belong to the realm that may be classed as past finding out.

Horsepower.

Owing to a scheme of James Watt's to make steam engines to appear of more capacity than they really were they were reckoned in horsepower that was greater than any horse could exert unless for a spurt. The standard horsepower established by Watt is 33,000 pounds raised one foot per minute or its equivalent.

Endurance is the horse's weakest point. Ten hours a day is often assumed as his working period Authorities claim that eight hours is better, or that six under a heavier load will accomplish the same volume of work with less tear and wear on the horse. The average farm horse cannot be depended upon for more than thirteen to fifteen miles of pull a day, nor more than four to six hours of work per day, as an average of even the busiest months. Properly handled, working six hours a day, well and carefully fed, a horse may have a working life of ten years of 1,000 hours each. The average farm horse will do well to develop 500 horsepower hours per year, or 5,000 in ten years. About 20 per cent. of the horse's weight may be taken as his maximum sustained draft, and six to eight miles per hour as his maximum sustained speed for anything more than an hour or so per day. The draft horse ordinarily gives the largest volume of work per day at about one-half his maximum load and one-third his maximum speed.

Flying Trains.

War is a scourge of the human race, but strangely enough developing the arts of war has frequently promoted arts of peace. Forging swords taught followers of peaceful industry to forge plowshears as they never had been made before; the boring of cannon taught mechanics how to apply the lathe and the boring mill to many peaceful purposes. Now there seems to be a probability that the construction of flying machines will pave the way to the making of flying trains. An article that recently appeared in the London *Times* says:

At the present period of time it would be rash to affirm that anything not logically and mathematically impossible is beyond the range of human invention and achievement. Man's ingenuity, aided by science, have accomplished the seeming impossible in the past, and, undoubtedly, more marvelous triumphs remain yet to become actual facts of human experience.

The latest on the tapis, a flying train, is the project of an ingenious Frenchman, M. Emile Bachelet. This has really gone so far beyond the experimental stage, that is has been actually accomplished, to the surprise and astonishment of scientists that were privileged to see it in operation.

This wonderful train is situated near the lines of the Great Central and Metropolitan Railways, and within five miles of the city bounds of London. The object at present is to put this levitated railway to a practical test so far as conveying the mails is concerned.

Hitherto M. Bachelet's invention has only been demonstrated in model form, and it remains to be seen whether the speed of 300 miles an hour which is claimed for the "flying train" can be attained. It is stated that it will take about three months to complete the mile-long track, which forms only a beginning, as it can be extended as necessity requires. It is claimed that the new railway will reduce the time of carrying mails to a minimum, the trains making the journey from London to Birmingham in a quarter of an hour, to Manchester or Liverpool in 48 minutes, and to Glasgow in an hour and a quarter. M. Bachelet states that it was during the last 25 years of research he made his discovery of the electro-magnetic waves or flux which have issued in this new mode of locomotion. They were in no way to be compared with the X rays with their burning property, or with any other known rays.

The commercial side of his inventions are not of particular interest to M. Bachelet. He states that he strives to discover the means whereby he can help suffering humanity, and in the utilization of the electro-magnetic waves he believes he has found an instrument which will rid mankind of consumption, pneumonia, cancer, insomnia, and other dread ills to which the human flesh has long been heir.

The French inventor's sanguine anticipations relative to the pathological uses of the electro-magnetic waves are probably doomed to disappointment. Cure-alls in the sphere of medical practice are nothing new, and have been almost invariably regarded with distrust by eminent practitioners of the healing art. M. Bachelet's levitating train may prove a success, though scarcely to the surprising extent stated and probably expected by him.

The energetic secretary of the Traveling Engineers' Association, Mr. W. O. Thompson, is making a vigorous effort to increase the roll of members. He intimates that the dull months of the year form the best time for urging elegible men who are still out in the cold to become members of this admirable association. So say all of us. Friends get busy.

If you have a good system of indexing or cataloging the important items and articles appearing in your railroad papers, you will find it will be convenient when you desire to quickly secure some data on an important subject. The successful railroad man today is up-to-date, but he must keep in touch with what is going on outside of his immediate vision.

Air Brake Department

Air Brake Tests.

Although [illegible] Westinghouse air brake tests were conducted in 1913, the report was not compiled and made public until quite recently, and at the present time they cannot be promiscuously circulated as but a limited number of copies have been printed and distributed among the officers and air brake men of the companies which conducted the tests. For this, among other reasons, it is desired to comment upon these tests and to acquaint our readers with the principal objects of the tests and some of the information derived from them, but it is obvious that the wide scope of the demonstrations, a report of which consists of a large volume of about 400 pages, precludes the possibility of a thorough resumé in the limited space of a monthly publication. The report is, however, an authorative reference and constitutes an air brake text book that will be used by air brake experts for years to come and possibly as long as the air brake is in existence.

Primarily the objects of the tests were to determine the best air brake mechanism and foundation brake gear for heavy steel passenger cars, with which it is desirable to make as short a stop from high speeds as was possible with the lighter equipment used some years ago, and at the same time the Pennsylvania Railroad demanded a brake that would also show [illegible] both [illegible] stops and an improved action during release of brakes. The design of such a brake necessitated [illegible] types of brake mechanism and foundation brake [illegible] to determine the degree of emergency braking force that could be employed and their various effects upon the comparative length of the stop. For the purpose of comparison and to determine the actual shortcomings of the present type of [illegible] was thoroughly tested out while the U C [illegible] (Electro Pneumatic) were relied upon to manifest the desired improvement. A 12-car train of 120,000-lb steel passenger coaches and a modern Pacific type of locomotive were used. The tests were conducted at Absecon, N. J., on the W. J. & [illegible]

The track upon which the running tests [illegible] and the track was wired for circuit break- [illegible] clock and chronograph located near the trip, the exact speed of the train before and during the stop could be ascertained.

It will not be necessary for our purpose to give a detailed account of the apparatus used on the cars and locomotive beyond that reliable apparatus for indicating the speed, and a distance machine for indicating the distance traveled beyond the point of brake application was used on the locomotive, while the cars were fitted with brake cylinder indicators and wheel sliding indicators. One car contained the chronograph and certain cars were fitted with slack action indicators; telephones and specially designed apparatus was used to determine the efficiency of the brake rigging.

Among some specially constructed devices used, the apparatus for determining the brake rigging efficiency is a device consisting of a soft steel plate of known hardness and uniform structure and was used to record the pressure with which a hardened steel ball was pressed against it; during a brake application the depth of the impression being proportional to the force. This was located in the brake rigging as near the shoe as possible so that the force transmitted by the brake gear passed through the ball to the plate while effective on the shoe. The diameter of the impression was measured with a micrometer microscope and the corresponding pressure determined from a calibration curve of similar impressions made under direct known pressure on a testing machine. The ratio of the pressure at the brake shoe as found by this method to the brake shoe pressure that should result from the cylinder pressure and the total leverage ratio known to [illegible] mechanical [illegible] in per cent.

The wheel sliding indicator is an improvement upon the older method of observers riding the platforms and throwing off some object at the point any wheel started to slide. This mechanism consists of a spring motor-driven drum on which records were made by five pencils, four connected to contacts arranged so that a magnet circuit was made and broken once for each revolution of the axle, the turning of each axle being represented by the pencils. The fifth was connected in the distance machine circuit, machine located on the locomotive, and each fifty feet traveled during the stop was recorded simultaneously with the revolution of the axle.

The distance recording machine, operated through the medium of the engine truck wheel, which broke the circuit every fifty feet traveled was so interlocked with the trip which applied the brakes that the point of application was indicated on each wheel sliding record.

The slack action recorders were similar instruments with a drum driven at a constant speed. These were securely fastened to the floor on several cars, and the pencil tracing on the drum was attached to an adjacent car by means of a wire under spring tension. As long as there was no relative motion between the adjacent cars, the pencil was stationery and traced a straight line on the diagram and any change in slack caused a movement of the pencil. A time record was also provided for these instruments, so that it was possible to note the exact time and place of any decided change in slack.

In order that the most accurate results of these tests could be obtained, the atmospheric temperature, relative humidity and rail conditions were noted during frequent intervals of the day. Rail conditions or the coefficient of rail friction was determined by means of an apparatus which pressed a block of tire steel down on the rail with a force that could be varied, the average force required to move or keep moving the block of steel on the rail determined the rail friction existing at that particular time.

The chronograph is an electrically attached instrument used to simultaneously record the brake pipe pressure, brake cylinder pressure, length of stop and time of stop and at the same time a continuous record of speed and continuous record of deceleration is traced. This machine, the paper of which is driven from an idler running on the rail, is of course absolutely accurate in registering the performance of the brake.

A number of different types of brake shoes were used for a comparison of performance in actual service, but the investigations into the subject of brake shoe friction were largely made in laboratory tests as it is the most accurate way of determining the characteristics of brake shoes, or brake shoe friction.

In the following an effort will be made to state very briefly the principal improvements manifested by the U. C. and electro pneumatic brake over the high speed brake.

By U. C. equipment it is meant that the universal valve, which replaces the triple valve, is pneumatically operated and when the symbol U. E. is used, it means that the universal valve was electrically operated. The U. C., which will be used until the

majority of cars or a sufficient number are equipped to warrant electric transmission, first provides a greater flexibility for service operation than the triple valve equipments. This is brought about by proportioning the volume of the auxiliary reservoir, service reservoir and brake cylinder to produce a 50-pound brake cylinder pressure from a 20-pound brake pipe reduction and basing the nominal service braking power at 90 per cent. from a 24-pound auxiliary reservoir reduction. Thus a 24-pound brake pipe reduction is necessary to produce the full service braking effect, as larger sized reservoirs require less reduction to produce the same cylinder pressure, the application of the U. C. brake permits of more time in which the engineer can exercise his judgment as to rate of retardation and how best to control the speed of the train.

The U. C. is more positive, sensitive, and more prompt to release, and the presence of universal valves mixed with triple valves results in an improvement in the release action of all brakes.

All service stops with mixed equipment were free from objectionable shocks. Shocks during emergency stops with triple valve equipments using 113 per cent. emergency braking power and U. C. at 150 per cent. were not severe enough to be prohibitive.

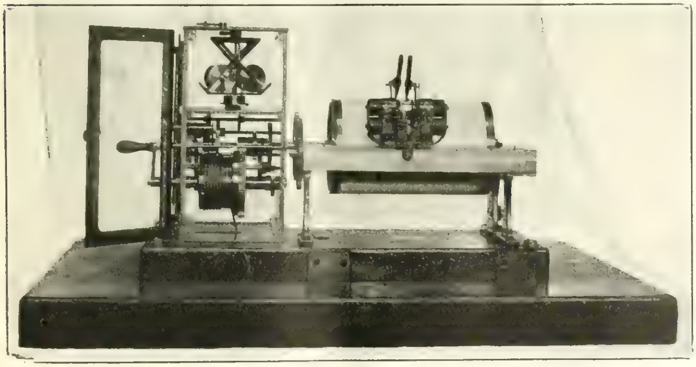
With the U. C. and U. E. brakes there is an efficient emergency brake available at any time during a service application. The P. M. brake will not work in quick action following a partial service reduction. The use of emergency position of the brake valve after a partial service reduction does not shorten the full service stopping distance, when the P. M. brake is considered, and these stopping distances from 60-mile per hour speeds averaged from 2,000 to 2,250 feet.

With the U. C., quick action and full emergency pressure is always available during a service stop and approximately 200 feet will be cut off of the length of a stop when full service is followed by an emergency application, and 300 feet will be cut off when emergency follows a partial service application.

With the U. E. brake a full service stop is made from the 60 M. P. H. speed in 2,000 feet, full service followed by emergency in 1,700 feet, and partial service followed by emergency in 1,540 feet.

The effect of the time element in the serial action of pneumatically operated brakes is to produce shocks, especially when emergency stops are made from low speeds; the electric pneumatic brake eliminates the time element and all shocks except those due to differences in braking power between the locomotive and cars. Smooth stops can be made with the graduated release feature of the universal valve and to use this method of release results in a saving of compressed air, time and distance in making a stop.

To note the effect of a closed angle cock on charged cars if an application was made while the cock was closed, an experiment was made and the U. E. brake applies all brakes in full, but the brakes back of the closed cock cannot be released or recharged before the cock is opened. It is considered that the failure to release will provide the factor of safety even if a closed cock will not prevent the application of the brakes.



CHRONOGRAPH CONNECTED WITH TRACK CIRCUIT.

The time of brake application, full service reduction, on a 12-car train by the three types of brakes shows that on the first car the P. M. applies or starts to apply in one second, the U. C. in three seconds, and the U. E. in three seconds. Brakes start to apply on all cars, P. M., 3 to 4 seconds; U. C., 5 to 6 seconds; U. E., 3 seconds. Full brake cylinder pressure is attained, P. M., 12 seconds; U. C., 16 seconds; U. E., 9 seconds.

The U. C. and U. E. consume more time than the P. M. in starting to apply, because the universal valve is designed so that it will not apply with less than a 5-pound brake pipe reduction, consequently the P. M. starts first, but the time of obtaining an effective brake cylinder pressure is the same with either brake. Why it is desirable to consume more time in obtaining a full brake cylinder pressure in service with the U. C. than with the U. E. has already been mentioned, and it will be understood that with the U. E. the time element is eliminated and all brakes start in 3 seconds and fully applied in 9 seconds, with no necessity for extending the time limit for full service operation.

The result of an emergency application is that the brake on the first car will apply in less than 0.5 of a second with either of the three brakes; on all cars the P. M. is applied in 2 seconds, the U. C. in 1.5 seconds, and the U. E. in less than 0.5 second. Full brake cylinder pressure is obtained on the P. M. in 8 seconds, the U. C. in 3.5 seconds and the U. E. in 2.25 seconds.

Emergency stops from 60 M. P. H. speeds on a level track, P. M. brake with 113 per cent. braking power, averaged about 1,600 feet. The U. C. at the same speed, but with 150 per cent. braking power, cuts off 200 feet, and the U. E. with 150 per cent. braking power brings the length of stop to less than 1,200 feet. The shortest stops made by these 12-car trains was 1,021 feet, U. E. brake, 180 per cent. braking power. It will be understood that the term braking power means the calculated or nominal unless otherwise stated.

A large number of breakaway stops were made during the tests; the idea is to know the possibilities of the car brake equipments under conditions where they are not compelled to furnish a portion of the retarding effect for the locomotive, not that the locomotive brake was inefficient for normal percentages of braking power, but when 150 per cent. and 180 per cent. braking power was used the locomotive naturally would run further than the train. When breakaway stops were made the locomotive was uncoupled before the trip was reached and the length of train stop measured.

As a result of these series of tests, a curve plotted to show the distance in which a train of 12 modern steel cars and a locomotive can be stopped from various speeds, indicates that with the U. E. equipment, 180 per cent. nominal braking power, clasp type of brake rigging and plain cast iron shoes, the stops will be as follows:

Speed M. P. H.	Distance in feet.
[illegible]	[illegible]
75	1800
70	1500
[illegible]	[illegible]
[illegible]	[illegible]
55	800
[illegible]	[illegible]
[illegible]	[illegible]
40	320
[illegible]	[illegible]

A glance at the figures will easily demonstrate the efficiency of the electro pneumatic brake.

An official of the Interborough Rapid Transit Co., at a railroad club meeting recently said, if the New York Subway, hauling 1,200,000 passengers daily, was to discard the electro pneumatic brake and return to a strictly pneumatic brake, the subways would be tied up and about 400,000 people would be compelled to find some other means of transportation or walk home. These words indicate that the capacity of the subway would be reduced to transporting 800,000 passengers daily, or that the addition of electric current to an already improved pneumatic brake has increased the capacity of the subway about 33 per cent.

It is also interesting to note that the length of the train of 12 cars and locomotive was 1,040 feet, and a stop from 60 M. P. H. was made in 1,021 feet, showing that the distance of the stop was less than the length of the ordinary passenger train. With this electro pneumatic brake stopping distances with emergency applications decrease with an increase in the per cent. of braking power employed. An approximate expression for the variation in the per cent. of emergency braking power and length of stop is: that for an increase in 5 per cent. in braking power, the length of stop is decreased 2 per cent.

Investigations to determine the nominal per cent. of braking power that can be used for emergency stops without danger of injury to the wheels from sliding is a very important consideration in the design of a brake, and previous demonstrations show that with all cars braking at practically the same ratio, 180 per cent can be utilized, and the conclusions arrived at during the P. R. R. demonstrations will be quoted verbatim from the report.

"The amount of wheel sliding depends more upon rail and weather conditions than on the percentage of braking power. The determining factor in wheel sliding is not high braking power alone, but rather the uncontrollable rail and weather conditions in connection with it, against which no permanent provision can be made without a sacrifice in the length of emergency stops during those favorable periods or seasons of the year when conditions warrant the use of high braking power. The coefficient of rail friction increases with increasing temperature and decreasing relative humidity, and decreases with increasing relative humidity and decreasing temperature. The average rail condition changes with the seasons of the year (and, to a less degree, with the time of the day) and advantage can be taken of this fact by using a higher braking power in the summer than could be used in the winter without likelihood of a material, if any, increase in wheel sliding."

Some wheel sliding occurred in 22 per cent. of the tests at an emergency braking power of 150 per cent., and in 20 per cent. at 180 per cent. braking power.

The effect of wheel sliding is to lengthen the stop, but the extent of the lengthening depends upon the amount of the wheel sliding and the braking power being used.

Whether the sliding of wheels will or will not cause flat spots of a sufficient size to produce rough riding of the car depends entirely upon circumstances; for example, a condition of rail surface that will cause a considerable amount of wheel sliding, with relatively low percentages of braking power, is a condition which at the same time will permit long slides to occur without producing noticeable flat spots.

"On the other hand when rail conditions are good or in the extreme case of sanded rail a very short slide may produce flat spots of sufficient size to require prompt attention. The amount of flattening is further contributed to by the weight upon the wheels and the material in the wheels and rail. The effect of rail conditions on the amount of flattening produced was brought out during the tests, there being many cases observed where the wheels picked up and slid for considerable distances on a bad rail producing but small flat spots, whereas with better rail conditions instances of wheel sliding were observed to produce flat spots of considerable size when the wheels slid a much shorter distance. No flat spots of sufficient size were obtained to necessitate changing wheels during the tests, although, it was found advisable, on account of the number of small spots accumulated on the wheel tread, to change some wheels before the cars were put back into regular service."

As to the variation in rail friction during different periods of the day, common experience leads us to expect a bad rail condition with a combination of low temperature and high humidity, and the conclusions follow from a knowledge of rail conditions in general and their effect irrespective of the readings of the apparatus used to determine the coefficient of rail friction during the tests. As a matter of fact, there is no great consistency between the readings obtained and the amount of wheel sliding experienced. While, as a rule, the greatest amount of wheel sliding occurred during the first runs of the morning, at which time the coefficient of rail friction was usually low; it was also a noticeable fact that occasionally considerable wheel sliding oc-

BRAKE CYLINDER PRESSURE INDICATOR

curred when the coefficient of rail friction noted previous to the test was about its average value.

A study of the action of the train where wheel sliding occurred, and the coefficient of rail friction noted at the same time, led to the conclusion that other factors, such as shock, slack action and foreign matter on the rail surface have a controlling influence in causing wheel sliding.

The arrangement of the by-pass valve to produce higher braking power on the locomotive and having a blow-down feature when the U. C. and U. E. equipments are used on the cars has advantages of, shock between the cars and the locomotive practically eliminated, shorter stops, and no more wheel sliding than to be expected with the present installation of the E. T. equipment.

The reader will understand that as stated, the objects of the tests was not solely for the purpose of ascertaining emergency stopping distances, which, however, determine the efficiency of a brake, hence a study of foundation brake arrangement and retarding force that may be expected from the brake shoe must of necessity be taken from the most severe conditions encountered, i. e., the emergency stop. Those of our readers who have followed the development of the passenger car brake already understand that the distance in which a train stop can be made depends principally upon the brake cylinder force that can be developed, the time in which it is obtained, its effect upon the brake shoe (brake rigging efficiency), and the average coefficient of brake shoe friction that can be realized, and to the air brake student the most interesting discovery during the tests is a determination of a reasonably accurate value of the average coefficient of brake shoe friction that can be developed under modern air brake conditions and the actual efficiency of a well designed brake gear. During the Lake Shore brake tests, abnormal brake shoe pressures developed by the P. C. equipment made it practically impossible to determine a fair average coefficient of brake shoe friction as the increase in brake cylinder piston travel in quick action applications over that in standing tests, which was at times as much as four and five inches, indicated that the brake rigging as a whole was decidedly inefficient, rather than to furnish a basis for determining an average value that might be expected from a well designed brake gear. The following table gives the figures of brake rigging efficiency multiplied by average coefficient of brake shoe friction that was obtained from the Pennsylvania-Westinghouse tests, where most modern type of brake gear was in use. It will be observed that both plain and flanged brake shoes were used with both the single shoe and with the clasp brake gears, and these values once established make it possible to calculate the distance in which a train can be stopped with the brake without any further necessity for emergency brake tests.

VALUES OF COEFFICIENT OF FRICTION X BRAKE RIGGING EFFICIENCY

Speed m.p.h.	Per Cent Braking Power	Clasp Brake. Plain Shoe.	Clasp Brake. Flanged Shoe.	[illegible] per Wheel. Plain Shoe.	[illegible] per Wheel. Flanged Shoe.
	[illegible]	0.141	0.169	0.108	0.11[illegible]
40	150	[illegible]	0.184	[illegible]	[illegible]
	180	0.118	0.141	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
60	[illegible]	[illegible]	0.11[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
80	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Value of data uncertain [illegible] brake shoe conditions.

Before making any further comment on the subject of braking power, it may be well to state that the term per cent. of braking power in itself is a vague and meaningless expression which has long been accepted in the nomenclature of the air brake art or in air brake parlance, largely because no one had introduced a more explanatory or expressive term. The word power used in this sense is a misnomer, since power is the rate of doing work and there is no fixed relation between "braking power" and the length of a train stop. This has of a necessity been used in the same general sense that "emergency" or "emergency application of the brakes" is frequently used when references are made to a quick action application of a brake mechanism.

Mr. Turner, however, makes it clear to us that a more appropriate or more expressive term for braking power would be "braking ratio" when brake installation is under consideration and gives us the term "factor of retardation" as the criterion of brake performance, as the factor of retardation is the ratio between the average actual stopping force realized and the weight of the car. These decisions appear in a very technical paper in which Mr. Turner dwells upon braking power and points out its general misinterpretation and the fallacy of specifying a certain per cent. of braking ratio based upon a certain brake cylinder pressure and offers instead, and as a standard for passenger brake installation, a service braking ratio of 90 per cent., from a 24-pound auxiliary reservoir reduction and to be obtained in 7 second's time. At this time it is not desired to comment upon the above as we are only concerned with the terms used and hereafter in reference to installation "service braking ratio" or "emergency braking ratio," as the case may be, will be used and "factor of retardation" when the average actual stopping force is compared with the weight of the car.

During the tests an efficient type of clasp brake rigging was found to reduce brake shoe wear, and a certain variable shoe action, and to prevent certain losses in braking force emanating from excessive piston travel, undesirable journal and truck movement, and also to result in a higher coefficient of brake shoe friction than can be obtained from single shoe installations.

Referring to the table of shoe friction X brake rigging efficiency, and to the formula L II printed in the November issue, which we at that time requested our readers to retain for future references, it will be noted that the stopping distance of a car or train of cars with an air brake is calculated from a formula

$$S = \frac{V^2}{2\ g\ P\ e\ f}$$ wherein,

S = Length of stop in feet.

V = Velocity in feet per second.

g = Acceleration of gravity (32.2 feet per second).

P = Per cent. of braking ratio.

e = Per cent. of brake rigging efficiency.

f = Coefficient of brake shoe friction.

From this formula and the table a comparison may be made of the efficiency of the different brake shoe and foundation brake arrangements by a calculation of the emergency stopping distances. At 60 miles per hour, 150 per cent., the recommended emergency braking ratio, the value e X f from the table, for a plain shoe with standard rigging is 0.068, and with the clasp brake 0.094, and with the clasp brake and flanged shoes 0.112, so that the stopping distance for a car with the single shoe per wheel and standard rigging would be $V^2 = 88 \times 88 = 7744$. $2\ g\ P = 2 \times 32.2 \times 1.5$, and as e X f = .068, $96.6 \times .068 = 6.56$. $7744 \div 6.56 = 1180$ feet distance from the point at which full braking force is obtained, but as this cannot be obtained within 2 seconds of the time of the beginning of the brake application, the actual stop will be 1180 + 88 = 1268 feet.

This additional 88 feet is derived from the law of averages where it may be assumed that as braking force rises from 0 to maximum in 2 seconds, the average force is one-half the maximum or conversely, one-half the maximum force for two seconds is equal to maximum force effective for one second; hence it is obvious that in effect the car runs for one second or 88 feet distance without any braking effect.

With the same speed and emergency braking ratio, the clasp brake with plain standard cast iron brake shoes, the value of e X f is 0.094, therefore the use of the clasp brake, everything else being equal, will be $96.6 \times 0.094 = 9.08$. $7744 \div 9.08$ [illegible] 941 feet stopping distance.

With the flanged brake shoe and clasp type of brake, same speed and braking ratio, the table shows the value of e X f to be 0.112, and the stopping distance with such a combination will be $96.6 \times 0.112 = 10.8$, and $7744 \div 10.8 = 717 + 88$ or 805 feet will be the actual length of the

stop from a 60-mile per hour speed with this brake, this, of course, assumed to be a single car, and it corresponds very closely with actual results obtained during the tests where a car with this braking combination was stopped from a 60-mile per hour speed in 725 feet, on a level track, when using 180 per cent. emergency braking ratio.

From the report of these demonstrations air brake men are gratified to note that the air brake, through improved apparatus, has not only kept the pace with increasing weights of equipment and further complications in operating conditions, but has gone ahead of absolute requirements, in that recently developed types of air brakes embody special features and functions through which maximum sizes of brake cylinders and permissible total leverage ratios are not necessary for the heaviest of car construction. This leaves a considerable margin for further development, and stopping distances with standard cast iron brake shoes and standard brake rigging are within the 1200 feet limit specified by the master car builders, and with the clasp brake and flanged shoes (which can be successfully used if correctly installed) the electro pneumatic brake will stop the modern steel passenger train in less than 1,000 feet from a 60-mile per hour speed, or in as short distances as the lightest cars were ever stopped by any brake.

Hardening Taps.

In the making of taps the tap should be annealed during the process of turning three times, to disperse internal strains— [illegible] once when finished to size, and once after the thread is cut and the flutes milled out. It should then be coated with linseed-oil and lampblack, or the composition paste. [illegible] should it be heated for quenching in a molten bath without this covering, or the contents of the bath, whether lead or salt, will hang in the teeth of the tap and prevent contact with the quenching water, so leaving soft those parts requiring the greater hardness in the tool. The tap should be inserted in the centre of the bath, to insure the greatest equality of heat on every side. As soon as the test-rod (made of [illegible] a rapid swirl around, and quickly plunge the tap, quite perpendicularly, into the [illegible] object of these precautions is to prevent [illegible] with a long tap, for a tap requires to be perfectly straight, or it will be certain to [illegible]

Green Color on Copper.

[illegible] possible free from any grease. Now take a piece of clean tow, dip it in dilute liquor ammonia, and rub it over the copper, avoiding as far as possible its drying in patches. Repeat this several times, allowing the moisture to dry off slowly. If the ammoniacal vapors are too strong for you, you may dissolve ¼ lb. of salammoniac in one quart of water, and paint the sheet over with this solution several times at intervals, allowing it to dry slowly on the sheet.

Drilling Hard Steel.

A mixture which will permit hard steel or iron to be drilled with ordinary drills is made by using 1 part spirits of camphor and 4 parts turpentine. Mix well and apply cold, letting it remain a few minutes before applying the drill. Run the drill slowly with fine feed.

Cement for Steam Pipes.

To make a permanent cement used for stopping leaks in steam pipes where caulking or plugging is impossible, mix black oxide of manganese and raw linseed oil, using enough oil with the manganese to bring it to a thick paste; apply to the pipe or joint at leak. It is best to remove pressure from the pipe and keep it sufficiently warm to absorb the oil from the manganese. In twenty-four hours the cement will be as hard as the iron pipe.

Blackening Brass.

The brass must be thoroughly cleaned, and then is heated slowly over a charcoal fire, care being taken not to allow the brass to touch the charcoal, or, indeed, not to allow any sparks from the charcoal to come in contact with the brass, or it will cause red spots. As soon as the brass is slightly red, dip it into nitric acid and reheat, just short of red. Rub strongly with a stiff bristle brush and clean with a greasy cloth. This gives a fairly permanent dead black finish.

Boiler Packing.

Take three pieces of pasteboard, about ⅛ in. thick, each piece about 3 in. larger than the manhole. Glue these together, making ⅜ in. thick altogether, then with pattern of manhole (this pattern with about 1 in. rim can be sawed out of a thin board and kept for future use) mark the straw-board when dry, and saw out with scroll saw. This packing will not shrink and split open like the ones made of wood.

Oil Paint on Cement.

There is [illegible] adhere to cement, but if the [illegible] first washed with 1 per cent. sulphuric acid (one part concentrated acid to one hundred of water), rinsed and allowed to dry thoroughly, the paint will find the surface suitably prepared for adhesion. Or the cement may be covered with three coats of water glass (silicate of soda), one part to four of water, and then painted. A first coat of linseed oil varnish followed by the usual paint is effective.

Iron Production.

When it comes to an article that can be used by all classes of people and promote the comfort of old and young, rich and poor, give us iron. Gold and silver hold the place of highest luxuries in the metal world while iron stands up as the most useful.

The production of iron in the United States has increased very rapidly in the last few years and the indications are that in a short time America will give out more iron than all the rest of the world. The annual output of iron ore in the chief producing countries during the latest period (average of 1909, 1910 and 1911) for which the figures are available, was: United States, 50 million tons; Germany, 27; United Kingdom 15; France, 14; Spain, 8; and Sweden, 5 million tons. Continued heavy production may be expected of the Lake Superior ores, the ores of the Franco-German boundary, the Bilbao ores of Spain, the Cleveland ores of England, and the high-grade magnetites of North Sweden; while increasing quantities of ores may be expected from Sweden and Cuba, and the use of Clinton hæmatites and Adirondack magnetites in the United States will also probably increase. In the near future there will probably become available the Brazilian high-grade hæmatites, Chilean ores, and ore deposits of the western United States, western Canada, India and China.

The Effect of Over-Counterbalance.

At a recent meeting of the Railway Club of Pittsburgh, Mr. G. M. Eaton, gave an interesting illustration of the rail damage caused by the action of locomotive over-counterbalance. It appears that some years ago the Baldwin Locomotive Works was conducting a trial run of a locomotive on a customer's tracks. The greater part of the track consisted of 80-pound rails, but a certain portion had been recently laid with 100-pound rails. During the test, a very high speed was obtained on the 100-pound section and the operation was apparently satisfactory. As soon, however, as the locomotive ran on the 80-pound rail a very decided disturbance was caused and the counterbalance produced a blow heavy enough to decidedly bend the rail toward the center of the tracks.

Hopper Cars for the New England Coal & Coke Company

The New England Coal & Coke Co. hopper cars were recently built by the Pressed Steel Car Co., and embody the usual types of construction for hopper cars excepting the weight has been kept as low as possible consistent with the capacity and service requirements. The general dimensions are as follows: Length inside, 30 ft. 0 ins.; width inside, 9 ft. 5½ ins.; width over side top angle, 10 ft. 0¾ ins.; length over striking plates, 31 ft. 6½ ins.; height from rail to top of body, 10 ft. 5 ins.; length of drop doors in clear at bottom, 2 ft. 6 ins.; length of drop doors in clear at top, 3 ft. 1 in.; width of drop doors in clear, 2 ft. 3⅜ ins.; cubic capacity, 1,770 cu. ft.

The center sills consist of two 15-in. 33-lb. channels, extending from end sill to end sill tied together and reinforced at top with ¼-in. tie plates at bolster and at bottom with 3½-in. x 3½-in x ⅜-in. angles. The end sills are 10-in 25-lb. channels reinforced at top with ¼-in pressed steel plate and at coupler opening with cast steel striking plate. The side sills are 10-in. 15-lb. channels extending from bolsters to end sill. The body bolsters are built integral with underframe, each consisting of one web plate of ¼-in. pressed steel, one malleable iron center brace, reinforced at top with 10-in. x ¼-in. plate and at bottom with 14-in. x ⅜-in. plate. The cross ridge is made of plates and angles and there are four diagonal braces made of 5-in. x 3-in. x 5/16-in. angles extending between bolster and end sills. The doors are made of ¼-in. pressed steel reinforced by flanges and channels, the hopper sheets, floor sheets, side and end sheets are made of ¼-in. steel. The end and side sheets are reinforced at top with 4-in. x 3½-in. x ⅜-in. bulb angles and the side sheets at bottom with 3-in. x 3-in. x 5/16-in. angles. The pressed steel side stakes are 3/16-in. material.

The car is equipped with the following specialties: Air brakes, Westinghouse, Schedule KD-1012; couplers, Simplex, cast steel 5 x 7-in. shank; coupler operating device, Imperial; door operating gear, Dunham; draft rigging, Farlow Sessions; truck frames, Andrews cast steel; truck bolsters, pressed steel; journal boxes, Symington; wheels, gray iron, 750 lbs.

TYPE OF HOPPER CARS FOR THE NEW ENGLAND COAL & COKE COMPANY.

Improving the Locomotive Boiler.

The fallacy which found numerous adherents for a time, that the tube surface was of little value in steam making, has been a costly piece of engineering heterodoxy to many railroad companies. The immense fire boxes that came into use as a substitute for tube heating surface have not contributed to the economy of fuel in ordinary service. Where a locomotive has to work nearly at its maximum power all the time, an immense grate area common to the large fire boxes will conduce to economy, but since a moderate quantity of coal will be consumed per foot of grate, but when an engine of this kind is required to work light, the consumption of coal becomes so low for the area the fire is spread over, that it is impossible to prevent waste by the cool air reducing portions of the firebox below the igniting temperature.

With a very large grate the tendency is to supply more air than the fire requires. Every cubic foot of air supplied beyond what is necessary for chemical combination, is so much superfluous gas that has to be heated and passed through the tubes. As the heat produced by a pound of coal is always the same, the temperature of the fire varies inversely with the quantity of air heated by the combustion. This being the case, it is not surprising that much disappointment has resulted from the promiscuous increase of grate area in locomotives that work light a great part of the time. The kind of coal to be used and the nature of the service the engine will be required to do, ought to influence directly the proportions of grate and heating surface to cylinder capacity. When these questions receive intelligent consideration, our master mechanics may safely depend on getting an economical locomotive boiler.

Hiring Men for Firemen.

A favorite work of the Traveling Engineers' Association has been giving instruction to locomotive firemen and the members have not yet become weary of well doing in this regard. An influential committee is now wrestling with "Recommended Practices for the Employment and Training of New Men for Firemen." The committee intimate that no set of questions can be asked that would have any particular bearing on the subject, as there are so many angles to it. The chairman, Mr. L. R. Pyle, therefore asks the members to send in general information as to what the practices are on their respective roads in the employment of firemen having in mind that they will be the engineers of tomorrow.

Generous to a Fault.

Murphy—"Did ye hear that poor Tim Casey's dead?" O'Flaherty—"Ye don't say so?" Murphy—"Yes, an' 'e's left all 'e 'ad to the Derry Poorhouse." O'Flaherty—"'Ow much did 'e lave?" Murphy—"A wife an' ten children."

Canadian Railways.

The year 1914 was one of general activity in railway building in British Columbia, due chiefly to carrying out construction programs prepared by the railways previous to the beginning of the financial depression. Two transcontinental lines, with Pacific coast terminals, were completed during the year, the Grand Trunk and the Canadian Northern, in addition to which the Kettle Valley Railway, an important branch line to the Canadian Pacific, will soon be opened for traffic. Important construction work was also carried on during the year in connection with the Esquimalt & Nanaimo system on Vancouver Island, the Pacific Great Eastern, the Kooteney Central and the Caslo & Slocan lines. The Canadian Pacific Railway was engaged in important improvements, including double-tracking a portion of the line in British Columbia, work on the Rogers Pass tunnel in the Selkirk Range, and the construction of a new terminal station in Vancouver. More than $26,000,000 were spent by the various railways in construction and improvement work in 1914, and over 1,900 miles added to the mileage of the several roads. The provincial government rendered important assistance in the way of subventions to the railway companies for construction work on the new lines.

The completion recently of two railway lines across the continent establishes three routes of communication in the Dominion that are transcontinental in the full sense of the word. The first of these lines connecting the oceans, the Canadian Pacific, was completed in 1888. Last September the gap in the Grand Trunk Pacific in the Rocky mountain region was closed, and a through-train service from Lake Superior to the Pacific Ocean entirely over its own lines established. In January the last spike was driven in British Columbia which united the eastern and western lines of the Canadian Northern Pacific, completing the third continuous line of steel between the Great Lakes and the Pacific coast.

Both of these new lines of railway are so nearly complete through the district north of Lake Superior, connecting the West with eastern Canada, that the completion of the roads in this province is virtually equivalent to tying together the Atlantic and Pacific oceans. In this respect the Canadian [illegible] truly tr[illegible]inental than those on any other part of the continent. They are true ocean-to-[illegible] and the accomplishment of difficult engineering feats, as the western sections [illegible] roads have received the encouragement of and liberal assistance from the Dominion Government, and also from the provinces through which the lines pass.

New Brunswick.

The facts that the New Brunswick Government has been enabled to complete a large section of the Valley Railway during the past year, and that it has also been able to issue bonds to retire indebtedness outstanding and falling due at a better rate than some other Canadian cities or provinces, speaks well for the general condition of New Brunswick finance. At the commencement of 1915 the Intercolonial Railway assumed the working of 120 miles of the Valley Railway, and trains are now running over between 80 and 90 miles of the section; a regular service is also expected to be shortly commenced upon the balance of the new mileage ready for working.

Canadian Steel Rails.

One of the largest Eastern American railroad companies has purchased from a Canadian steel-rail mill some 10,000 tons of steel rails, to be delivered in the course of this year. The original order, which amounted to 20,000 tons, has now been divided, as far as possible, equally between the United States and Canada. It is understood that the Canadian rails will be delivered at about $26.50 per ton. This purchase of Canadian steel rails by an Eastern American railroad company follows closely a shipment of steel rails from Canada to the Middle West of the United States. Canadian steel rails are admitted free into the United States, while Canada has imposed a general duty of $7 per ton upon American steel rails.

Protecting Iron from Corrosion.

Ferro-zincing or ironising as a means of protecting iron and steel from corrosion has many applications, one of the chief, at the present time, being for coating tubes to prevent pitting and corrosion. The use of zinc as a protective coating is due to the fact that zinc is electro-positive to iron and steel, and in the presence of moisture a galvanic couple is set up. The zinc, being electro-positive to iron, cor[illegible] left in contact with the iron the iron is protected. Mr. Cowper-Coles, the inventor of the process known as "ferro-zincing," has found by experiment that pure electrolytic iron forms a very effective protective coating, chemically pure iron being practically rustless. Thus if sheets of electrolytic iron and ordinary rolled iron be freed from scale and oxide and placed in a very dilute solution of sulphuric acid, and connected to a millivoltmeter, it will be found that the current flows in such a direction as shows that electrolytic iron is electro-positive to ordinary rolled iron. The only impurity of any importance in electrolytic iron is hydrogen, which appears to be partly alloyed with the iron, but this is found to render the iron more electro-positive; for if a piece of electrolytic iron be annealed, the hydrogen being thereby expelled, and then tested against a piece of unannealed electrolytic iron by the above test, it will be found the unannealed sample is electro-positive to the annealed sample. It will thus be seen that a coating of electrolytic iron forms an excellent protective coating, and if afterwards coated with zinc the result is still better.

Valuation of Railroads.

The government and the railroads are now engaged in making a valuation of the railroads. The railroads do not object to that work, although the cost will be very great. But in making that valuation *all* elements of value must be considered and the railroads should be protected by Constitutional guarantees just as well as all other property is protected. If this is done, the valuation will, in good judgment, in most cases, prove to be more than the capitalization, and the charge of over-capitalization will be refuted.

Valuations of railroads within their borders have been made under authority in four States, and the valuation was more than the capitalization in three out of these four States, and nearly the same in the fourth State, as follows:

	Valuation.	Capitalization.
Wahington (1905) ...	$194,057,240	$161,582,000
South Dakota (1908).	106,494,502	109,444,600
Minnesota (1907)	360,961,548	300,027,676
Wisconsin (1909)	296,803,322	225,000,000
Total	$958,316,613	$796,054,276

The Poor Roundhouse Foreman.

A speaker at the Traveling Engineers' Convention said: The roundhouse foreman, the bumping post of the railroad, is the last end of the string. He is the fellow who gets the blame and the only consolation that the poor roundhouse foreman has is to go out and curse the hostler. He has nobody else to fall back on. Make a friend of that fellow. Tell him your wants. See if you cannot get improvements made that will help you wonderfully in your daily tasks. If any man goes wrong, be kind, but place admonition or censure or discipline where it is deserved, but do it unswervingly. Let every man know that you are what you pretend to be.

The toad beneath the harrow knows
Exactly where each tooth-point goes;
The butterfly upon the road
Preaches contentment to the toad.

RUDYARD KIPLING.

Ross-Schofield System of Water Circulation

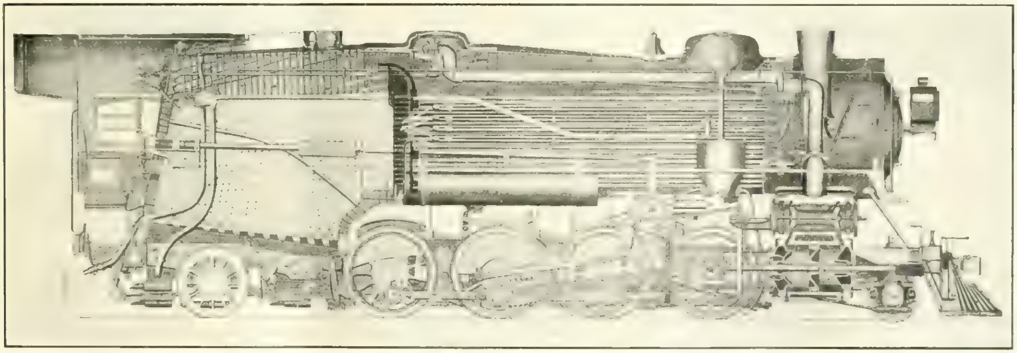
Among the recent marked improvements in boiler construction a decided advance has been introduced by the Q. & C. Company, 90 West street, New York, which bids fair to come rapidly into popular favor. It is known as the Ross-Schofield system of water circulation and has already been successfully adopted in a large number of marine and stationary boilers, and quite recently is being applied to locomotive service in several of the leading railroads in America. Very substantial working models are in operation at the company's demonstrating laboratory at 17 Battery Place, this city, where the appliance may be seen in miniature in operation.

As shown in the accompanying illustration, the device when applied to a locomotive boiler consists of a steel baffle plate placed about 12 inches in front of the tube sheet. This baffle plate completely encloses the water space in front of the tube sheet, excepting an open space at the top. There are also two openings at the sides of the baffle plate near the bottom. Vertical steel plates are also fitted between the tube sheet and baffle plate to within 10 inches from the mud ring and are supported by stay bolts. On the upper end of the baffle plate there is a curved hood attached extending a short distance over the firebox crown sheet. The appliance, it will thus be seen, is simple in construction and easily and economically applied to any kind of boiler either during construction or when flues are removed during repairs.

The action of the device will readily suggest itself to the observer. The water being admitted to the boiler in front of the baffle plate, the current of water is induced to pass through the two openings in the baffle plate, and this motion is directed up through the guiding compartment, and the curved hood has the effort of throwing the ascending stream of water in a horizontal direction over the crown sheet towards the rear of the firebox. This condition is quickly established and a longitudinal and elliptical circulation is carried on with a degree of velocity that is surprising and needs to be seen in operation in the working models to be fully appreciated.

It will be readily understood that in an ordinary boiler there is a very sluggish circulation which contributes to what is known as steam film, which frequently induces an overheating of the sheets and also permits what is known as printing. With a rapid circulation the steam film is entirely prevented, solid water is maintained against the sheet, the steam bubbles are readily released as they are constantly and rapidly swept into motion by the circulating current, and the more rapidly the water is passing over the hottest portions of the boiler, the greater will be the absorption of the heat units transmitted through the plates, thus increasing the rate of evaporation.

Nor is this all. The scouring effect of the water maintained by this rapid method of circulation keeps the plates clean and the impurities which are more or less present in water are not permitted to accumulate on the heating surfaces, but are carried down and deposited in the mud ring where the accumulation of particles may be readily disposed by the judicious and systematic use of blow-off cocks. This adds to the life of the boiler and reduces the amount of fuel necessary, or in other words, gives more power from the same amount of fuel. Eminent authorities agree that the costs of extra fuel caused by incrustation and extra repair, a loss of $750 per annum for every locomotive, in the middle and Western states, is a fair estimate. The reports already received from the railroads where the appliance is in operation justifies this estimate, and the operation of the device and its economical effects are attracting the attention of many leading railway men.



LOCOMOTIVE CHART SHOWING ROSS-SCHOFIELD SYSTEM OF WATER CIRCULATION
Illustration Copyrighted [illegible]

To Reduce Length of Trains.

We are informed that Assemblyman Mead has introduced a bill in the New York legislature making it illegal to operate trains more than half a mile long. The measure makes violation of the law a misdemeanor punishable by a fine of not less than $100 nor more than $500 for each offense.

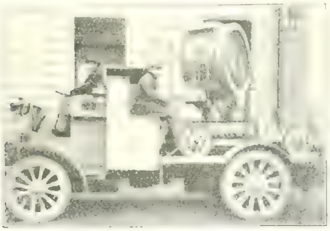
The bill was drawn by Judge John T. MacDonald. It is supported by the Brotherhood of Railroad Trainmen, which asserts that long freight trains give trainmen too much work and in addition tend to increase the danger to train crews. Assemblyman Mead is a railroad switchman and his bill is construed as retaliation on the part of railroad employees against the bill introduced at this session for repeal of the full crew bill.

The Oregon-Washington Railroad & Navigation Company is preparing to build a new terminal at The Dalles, Ore., at an estimated cost of $200,000. A 12-stall engine house is to be built; also a machine shop 40 by 40 ft., a power house 40 by 60 feet, a store house 40 by 80 feet, water tanks, coal plant, cinder conveyor, turntable and about two miles of new track.

Electrical Department

The Automobile Searchlight.

By reading the daily papers one learns of the importance of the part the automobile is playing in the present European war. Motor vehicles are being used for transportation of soldiers, for bringing supplies and rations to the firing line, for gun haulage, for ambulances and many other uses.



THE AUTOMOBILE PROJECTOR MOUNTED ON A TRUCK.

The French army make a novel use of the automobile and that is to mount on same a powerful searchlight. This searchlight can be easily dismounted and placed anywhere within a hundred yards of the automobile.

The automobile is fitted with an electric generator, driven by the main gas engine. The searchlights or projectors as they are called, are mounted on turntables so that they can be pointed in any desired position horizontally as well as through any angle vertically. A cable wound on a reel connects the projector to the electric generator. It is stated that the French army has no less than 50 of these powerful searchlights in operation along the battle front.

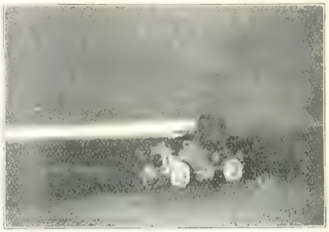
A Semi-Outdoor Portable Substation.

The Berkshire Street Railway Company, Pittsfield, Mass., placed in service this last summer a new semi-outdoor type of portable substation for the purpose of supplementing the power supply on certain heavily loaded sections of the road during the increased summer excursion traffic. The substation was built by the General Electric Company and has a continuous capacity of 300 kw. at 600 volts, transforming from a 33,000 volt, 25 cycle, 3 phase line supply.

By providing additional energy at any point where traffic may be temporarily abnormal a portable substation of this type assures a continuity of power supply at a lower cost than would be incurred by the installation of spare units in many of the substations of an electric railway system, resulting in a considerable reduction in investment for equipment that under normal conditions might lie idle for long periods. Moreover, the portable substation can be transported quickly to a disabled section, where it will only be necessary to make connections to the high tension lines and direct current trolley or feeders for a temporary power supply. It is also very useful for furnishing power to extensions while under construction.

The portable substation for this railway represents one of the most modern designs. It consists of an enclosed operating compartment containing the synchronous converter, the three-panel switchboard and the three unit electric heaters; an enclosed central room for the multi-gap lightning arrester equipment; and an open section for the main transformer, the current transformer, automatic oil switch, choke coils, disconnecting knife switches, etc. Owing to the low clearances of the various bridges on the lines, the car has been kept within the comparatively low height of 11 ft. 6 ins. above the rails, including the running board.

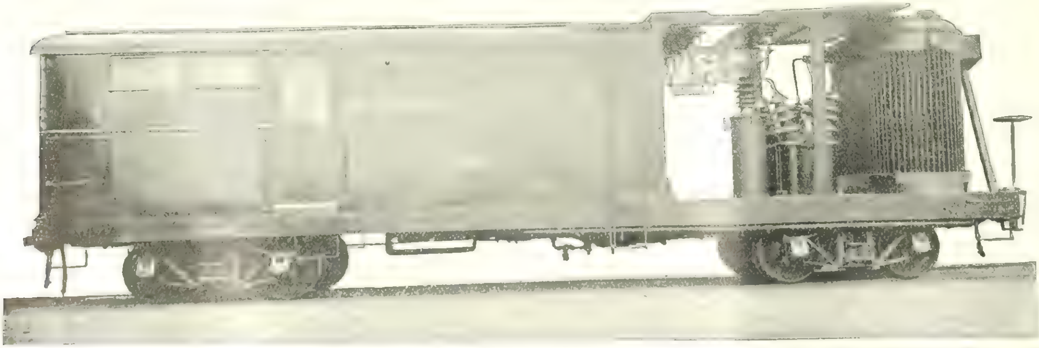
The car is provided with four doors, one on each side entering from the outside into the operating or synchronous converter compartment, one in the side of the partition connecting the operating and lightning arrester compartments, and one entering the latter compartment at the other end from the outdoor portion of the substation.



THE SEARCHLIGHT IN OPERATION.

The electrical equipment consists of: 3 phase, 25 cycle, 600 volt interpole rotary; 3 phase, 25 cycle, 33,000 volt oil insulated, self-cooled outdoor transformer; automatic oil circuit breaker; lightning arrester of the multi-gap type; choke coils and disconnecting switches; 3 panel switchboard; auxiliary apparatus.

The appliance is said to meet with much popular favor along the railway.



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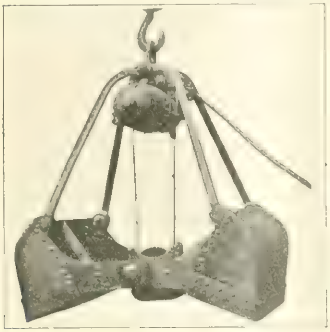
Clam-Shell Bucket Operated Electrically.

All that is necessary for the operating machine, handling one of the above buckets, is to raise and lower the same, the digging and dumping of the load being accomplished by means of a motor in the head of the bucket itself.



ELECTRICALLY DRIVEN BUCKET

All movable parts of the motor are inclosed in a heavy casing, with the electric power passing through a waterproof cable. An electric rheostat is provided so that from two to four speeds can be obtained each way. Hayward Company of New York City are placing this bucket on the market.

Steam Turbo-Generators.

Steam turbo-generator sets are made in various sizes and it is extremely interesting to know just what is the largest and the smallest sets which have been made to date. For the largest, 35,000 kw. or nearly 50,000 H. P., represents the capacity and the set is approximately 60 feet long. In striking contrast are the small sets for mounting on steam locomotives to supply electric current to the head and cab lights. These sets have a rating of 140 watts or approximately 2/10 of a horse power. The sets are only 23½ in long and weight only 130 lbs.

The Telescribe.

The telescribe is a new apparatus recently developed by Mr. Thos. A. Edison. It comprises a dictating machine equipped with telephone-recording devices.

To better understand the apparatus a short description of the dictating machine or dictagraph follows. The machine consists of a small electric motor, operating from the regular lighting circuit, which drives, at constant speed, a revolving barrel on which is placed a cylinder made up of composition. This cylinder can be started and stopped at will by means of a mechanically operated clutch. A carriage driven by a screw shaft is carried along the cylinder and causes a slight cut at very low pitch to be cut by a very small point located on the underside of the carriage. This point is fastened to a diaphragm which vibrates according to the various sounds and when a needle is run over these threads cut on the cylinder the sound is reproduced. It is the same as the photograph except that the dictation is put on a temporary cylinder.

The dictating machine is equipped with a micro-recorder which swivels into place over the cylinder and is wired to a telephone extension operated with its own small batteries. The latter is mounted on the user's desk. A telephone message is recorded in the following manner: The receiver of the regular desk telephone is removed from the hook and placed in the socket provided with the recording apparatus. In this way the acoustic connection to the dictating machine is made without danger of criticism from the telephone company, as the instrument is neither mechanically nor electrically connected to its lines. The user then takes up a small receiver and gives his call to the exchange, the conversation on both sides being recorded.

It is easy to realize what a source of value this instrument will be for there can be no misunderstanding as every word of the whole matter has been recorded and can be reproduced.

MR. EDISON TESTING [illegible]

Good Luck.

Is there any such thing as luck? There is undoubtedly something which we call luck that attends the operations of the successful man. An analysis of the conditions which are summed up under the mystic head of "luck" reveals that good fortune is based on something more enduring and tangible. Some of the things responsible for success are good judgment, self-denial and perfection of attainment as applied to the business in hand. Here is a young man whom we have always known. So far as we have observed he has never exhibited any brilliant qualities. He has been with one employer perhaps for a dozen years. Suddenly we learn that he has been placed in a responsible position to which a large salary is attached and which means great opportunities, or we notice, on going into business for himself, that success seems to attend his every effort and he prospers where others have failed. The universal observation is that this young man is "lucky," and it really appears so. But the young man knows better. Instead of "luck," he sees in his success nothing but the honest fruits of endeavor, self-sacrifice, study and ambition properly controlled. He remembers how hard he worked during those twelve years, how many disagreeable things he bore in silence, how hard he studied to master the details of his business, how he denied himself in order to [illegible]

Railroads in Burma.

The first 65 miles of the Southern Shan States Railway have been opened for traffic, and they bring Kalaw, the finest hill station in Burma, within 24 hours of Rangoon. Kalaw is 70 miles nearer Rangoon than Maymyo, and although, according to present arangements, a journey will occupy about the same time, when the new line is in thorough working order it will be possible to reduce the *trajet* by several hours. Kalaw is about 1,000 ft. higher than Maymyo, and it has a proportionately cooler climate and a smaller [illegible]

Items of Personal Interest

Mr. John A. [illegible] has been appointed car foreman of the Grand Trunk with office at Fort Erie, Ont.

Mr. E. A. Humphrey has been appointed electrical engineer of the Great Northern, with office at St. Paul, Minn.

Mr. G. D. Harris has been appointed master mechanic of the Midland Valley, with office at Muskogee, Mich.

Mr. G. R. Bissett has been appointed road foreman of engines of the Seaboard Air Line, with office at Savannah, Ga.

Mr. W. G. Davis has been appointed general foreman of the Detroit, Toledo & Ironton, with office at Springfield, Ohio.

Mr. J. Duguid has been appointed assistant mechanical superintendent of the Central Vermont, with office at St. Albans, Vt.

Mr. Charles Emerson has been appointed road foreman of engines of the Northern Pacific, with office at Duluth, Minn.

Mr. E. E. Blake has been appointed road foreman of engines of the Erie, with office at Susquehanna, Pa., succeeding Mr. L. Barnes.

Mr. J. T. Flavin has been appointed master mechanic of the Illinois division of the New York Central, with office at Gibson, Ind.

Mr. C. E. Stone has been appointed general car foreman of the Missouri & Northern Arkansas, with office at Harrison, Ark.

Mr. John O. Boyer has been appointed road foreman of engines of the Philadelphia & Reading, with office at St. Clair, Pa.

Mr. F. G. Grimshaw has been appointed assistant engineer of electric equipment of the Pennsylvania, with office at Pittsburgh, Pa.

Mr. S. S. Gordon has been appointed foreman of locomotive store orders of the Canadian Pacific at the Angus shops, Montreal, Que.

Mr. H. F. Staley has been appointed superintendent of motive power of the Boyne City, Gaylord & Alpena, with office at Boyne City, Mich.

Mr. D. E. Barton has been appointed acting master mechanic of the Santa Fe, with office at Argentine, Kan., succeeding [illegible]

Mr. F. W. Anderson has been appointed [illegible] Western, with office at Pierre, S. D., succeeding [illegible]

[illegible] succeeding Mr. A. E. Hopkins.

Mr. G. A. McGee has been appointed master mechanic of the Lorain, Ashland & Southern, with office at Ashland, Ohio, succeeding Mr. William Austin.

Mr. E. F. Needham, superintendent of the locomotive and car departments of the Wabash, has removed his headquarters from Springfield to Decatur, Ill.

Mr. J. L. Schriver has been appointed road foreman of engines of the New Castle division of the Baltimore & Ohio, with office at Chicago Junction, Ohio.

Mr. Harry H. Trenton has been appointed general foreman of the Missouri Pacific, with office at Kansas City, Mo., succeeding Mr. William Donahue.

Mr. A. C. Schneider has been appointed general foreman of the Cincinnati, New Orleans & Texas Pacific at the Ferguson shops, succeeding Mr. W. A. Ford.

Mr. George F. Fisher has been appointed master mechanic of the Cape Girardeau Northern, with office at Cape Girardeau, Mo., succeeding Mr. E. H. McCann.

Mr. A. Lindboe has been appointed locomotive foreman of the Chicago, Minneapolis & Omaha, with office at East St. Paul, Minn., succeeding Mr. F. R. Jones.

Mr. M. R. Feeley has been appointed general foreman of the motive power department of the Delaware, Lackawanna & Western, with office at Kingsland, N. J.

Mr. S. T. Armstrong has been appointed master mechanic of the International & Great Northern with office at Palestine, Tex., succeeding [illegible]

Mr. T. U. Brown has been appointed supervisor of locomotive operation of the lines of the Seaboard Air Line north and west of Columbia, with office at Hamlet, N. C.

Mr. A. D. Brice has been appointed master car builder of the San Antonio & Aransas Pass, with office at Yoakum, Tex., succeeding Mr. W. T. Couslay, resigned.

Mr. J. I. McConnell has been appointed foreman of the car department of the Chicago, Milwaukee & Gary, with office at Rockford, Ill., succeeding Mr. R. N. Dodge.

[illegible] superintendent of motive power of the South Dakota Central, with office at Sioux Falls, S. D., succeeding Mr. C. O. Destiche.

Mr. Geo. Thomson, district master car [illegible] wood, Ill., has had his jurisdiction extended over the Illinois division of the same road.

Mr. George S. Graham has been appointed master mechanic of the Pennsylvania division of the Delaware & Hudson, with office at Carbondale, Pa., succeeding Mr. John J. Reid.

Mr. Thomas P. Devitt has been appointed locomotive foreman of the Chicago, St. Paul, Minneapolis & Omaha, with office at East St. Louis, succeeding Mr. H. A. Enocksen.

Mr. R. Lilly, formerly car foreman of the Canadian Pacific at Three Rivers, Que., has been appointed night car foreman on the same road, with office at Place Viger, Montreal, Que.

Mr. A. R. Ayers, general mechanical engineer of the New York Central Lines west of Buffalo, has removed his offices from Chicago to the Grand Central terminal, New York.

Mr. O. S. Jackson has been appointed general superintendent of operating and mechanical departments on the Chicago, Terre Haute & Southeastern, with office at Terre Haute, Ind.

Mr. A. E. Hopkins, formerly road foreman of engines of the Seaboard Air Line at Hamlet, N. C., has been transferred to a similar position on the same road, with office at Americus, Ga.

Mr. E. J. Bryant, formerly general foreman of the International & Great Northern at Houston, Tex., has been appointed master mechanic on the same road, with office at Mart, Tex.

Mr. Joseph Chidley, superintendent of motive power and rolling stock of the New York Central, with office at Cleveland, Ohio, has had his jurisdiction extended over the Illinois division.

Mr. H. A. Enocksen, formerly locomotive foreman of the Chicago, St. Paul, Minneapolis & Omaha, at East St. Paul, has been transferred to a similar position on the same road at Altoona, Wis.

Mr. D. C. Messeroll, formerly car foreman of the Grand Trunk at Fort Erie, Ont., has been appointed general traveling car inspector of the Ontario Lines, and districts 8, 9 and 10, Eastern lines.

Mr. E. T. Huston, formerly assistant master mechanic of the Pennsylvania lines west of Pittsburgh at Crestline, Ohio, has been appointed assistant master mechanic on the same road at Fort Wayne, Ind.

Mr. F. W. Warren, formerly locomotive foreman of the Grand Trunk, at Coteau, Que., has been appointed locomotive foreman of the same road, with office at Southwark, Montreal Terminals, Montreal, Que.

Mr. John J. Reid, formerly master mechanic of the Pennsylvania division of the Delaware & Hudson at Carbondale, Pa., has been appointed master mechanic

of the Susquehanna division, with office at Oneonta, N. Y.

Mr. J. O'Brien has been appointed locomotive foreman of the Great Northern, with office at Interbay, Wash., succeeding Mr. R. E. Molt, who has been transferred to a similar position on the same road at Gold Bar, Wash.

Mr. E. G. Goodwin has been appointed fuel agent of the Southern railway, the Virginia & Southwestern and the Northern Alabama, with office at Knoxville, Tenn., and subsidiary offices at Birmingham, Ala., and Princeton, Ind.

Mr. T. C. O'Brien, formerly general boiler inspector of the Baltimore & Ohio Southwestern railroad, and Cincinnati, Hamilton & Dayton railway, at Cincinnati, Ohio, has been appointed general foreman at Lima, Ohio, and Mr. Martin Murphy has been appointed general boiler inspector at Cincinnati.

Mr. Alexander Young, formerly general foreman of the locomotive department of the Chicago, Milwaukee & St. Paul, at Chicago, has been appointed district master mechanic on the same road, with office at Milwaukee, Wis., and Mr. C. Lundberg has been appointed general foreman at Western avenue, Chicago, succeeding Mr. Young.

Mr. G. Whiteley, formerly master mechanic of the Alberta division of the Canadian Pacific at Calgary, Alta., has been appointed assistant superintendent of motive power of the Eastern lines, with offices at Montreal, Que., and Mr. C. Kyle has been appointed master mechanic of the Atlantic division, with office at St. John, N. B.

J. A. MACFARLAND

Mr. C. M. Newman has been apointed superintendent of shops of the Baltimore and Ohio Southwestern railroad at Washington, Ind., reporting to the superintendent of motive power at Cincinnati. Mr. A. E. McMillan has been promoted to master mechanic of the Indiana and Illinois divisions, at Washington, Ind., and has been succeeded by Mr. W. H. Keller, who became assistant master mechanic in charge of the Cincinnati terminals.

Mr. J. A. McFarland has recently been appointed Southwestern district manager of the Bird-Archer Company, with head-

WILLIAM H. WOOD

quarters in the Frisco building, St. Louis, Mo. Mr. McFarland is a graduate of the University of Illinois. He began railway work in May, 1903, being connected with the chemical department of the Santa Fe Railway at Topeka, Kan Leaving that railroad on January 1, 1904, he became assistant in the testing department of the Chicago and Northwestern Railway. In February, 1905, he became chief chemist of the Missouri Pacific Railway, where he was chief chemist until May, 1909, when he took charge of the St. Louis office of the Dearborn Chemical Company, looking after their railroad business in that territory. In July, 1911, he left that company to become chemist and engineer of tests of the Frisco System. Leaving that company he was connected with the Standard Railway Equipment Company until his recent appointment with the Bird-Archer Company.

Mr. William H. Wood, the well-known constructing engineer, Media, Pa., has recently constructed hydraulic shears for the New York Navy Yard, Brooklyn, for cutting steel plates 1½ inches in thickness. Mr. Wood has had a notable career in his chosen profession, and is justly entitled to the credit of introducing hydraulic machinery tools in America. The first flanging press for flanging locomotive boilers was made by him for the Cooke Locomotive Works at Paterson, N. J. He also introduced the first successful hydraulic machinery used in the construction of flanged steel car trucks and steel underframes. He was at Joliet, Ill., and the works became the nucleus of the Pressed Steel Car Company. Mr. Wood has also been eminently successful in introducing and improving hydraulic riveting, flanging and forming machinery, steam hammers, air compressors, hydraulic pumps and other machinery. As is well known to our readers Mr. Wood has also made extensive experiments on locomotive boiler construction, especially in the application of complete corrugated fireboxes. Official tests on the New York Central Lines and elsewhere of locomotive boilers so constructed have shown the practicability of the improvements. Mr. Wood is descended from an eminent engineering family in England, and an uncle having established the first engineering works in Leeds, England, and Mr. Wood's father being general manager of the well-known Naysmith engineering works in England, where the most of the locomotives for the London Northwestern and the Lancashire & Yorkshire railways were constructed, and where Mr. Wood served his apprenticeship as engineer and millwright before coming to America.

Mr. Lyndon F. Wilson, formerly vice-president of The Railway List Company, Chicago, has resigned to become vice-president of the Bird-Archer Company, of New York, effective April 1, 1915. Mr. Wilson was educated at Ripon College, Lawrence University, and the University of Wisconsin. Later, after a considerable machine shop and power plant experience, he became an engineer in the Interior Department in the service of the United States Government, after passing

L. F. WILSON

examinations in steam, electricity and heating and ventilating. After one year in this service he joined the engineering department of the Western Electric Company, and was so engaged until the fall of 1908, when he became mechanical department editor of the *Railway Review*. In

the spring of 1909 he became editor of the *Railway Master Mechanic,* and was subsequently given editorial charge of *Railway Locomotive Engineering*. He was promoted to the vice-presidency of this company in the summer of 1913. After April 1 Mr. Wilson will be located in the Chicago office of the Bird-Archer Company.

The atmosphere of the West has a strong influence in the development of men who become leaders in the railway world. The latest example of this appears in the person of Mr. George Bury, who has gone out of the Western Lines of the Canadian Pacific to become vice-president and general manager of the whole Canadian Pacific system. Mr. Bury, who is only 48 years old, entered the service of the Canadian Pacific as a clerk in 1883 and has risen steadily to the present position by the force of merit displayed in being thoroughly master of the details of every position he filled. We earnestly endorse every word of a review of Mr. Bury's career which recently appeared in a Canadian paper and reads:

"The West will note with lively interest and much satisfaction the promotion of George Bury, for the past three years vice-president for the C. P. R. Western Lines, to the position of vice-president and general manager of the whole system. For the people of the West regard Mr. Bury as one of themselves; and, admirably administered as the C. P. R. is, it will certainly not suffer by having as its chief executive officer, under the president, one who has an intimate knowledge of conditions in the West and has shown himself sympathetic towards the special problems with which this half of the Dominion has to deal. Mr. Bury has won this high position on his merits. He has climbed the ladder rung by rung. Beginning as a stenographer in the general offices, he rose step by step through the offices of divisional superintendent, general superintendent, general manager of western lines, and western vice-president to his new and onerous position, which, however, is not likely to mark the bounds of his career. In all of these capacities, Mr. Bury has made good. His [illegible] has been justly earned and is thoroughly deserved.

"Until within a few years, Mr. Bury's remarkable talents were applied almost entirely to the technical business of operating a railway [illegible] economically; but in the position which he has lately held in Winnipeg he has had to deal with the still more exacting problems arising from the adjusting of the relations between the railway and the public. There have been some classic examples of great railway operators making shipwreck of their careers by their inability to deal with the public. No man can be a great railway administrator in Canada at the present time unless he has many of the qualities of the successful public man. The people of the West, who have had substantial grounds for their grievances against the railways, have noted, with pleasure, increasing indications that Mr. Bury has the viewpoint of the modern twentieth century railway manager, which puts the railway where it belongs as the servant of the public which employs it and makes possible its success."

GEORGE BURY

We regret to learn that Mr. P. Fennell, known as Shandy Maguire the poet of railroad train men, is in very precarious health and is sojourning in a health resort. Shandy is a wonderfully genial and popular man and we earnestly hope that he will soon resume penning [illegible] the humorous verses for which he has been noted these many years. The last lines [illegible] reads:

"An' here's a hand', my trusty freen,
And' gies a han' o' thine;
We'el tak a richt gind Willie Wacht,
For auld lang syne."

P. FENNELL

'Deed No'.

The Rev. Dr. Donald Macleod, in the life of his brother Norman, relates an anecdote illustrative of smuggling in the good old days. An old woman, whose habit and repute was notorious, was being tried by the Sheriff of Argyllshire. When the charge had been clearly proved, and it fell to the judge to pronounce sentence, he became unusually fidgety, and thus addressed the prisoner—"I daresay, my poor woman, it's not very often you have fallen into this fault?" "'Deed no', Shirra," she readily replied, "I haena made a drap since yon wee keg I sent to yersel'."

A Woman's Bargain.

An Oil City man, who was detained at the house for a part of the day, handed his wife, who was going down-town, a quarter of a dollar and requested her to get him three cigars for it.

When she returned she handed him the package, remarking, exultantly:

"That shows that women can beat men all hollow when it comes to making purchases. I found a place where I could get eight for a quarter instead of three. Isn't that going some?"

And the poor man, as he took his medicine, merely remarked:

"It certainly is, dear."

A Philadelphia Story.

A Philadelphia minister told a story recently of the conversion to a religious life of a worldly woman. "I used to be," said she, "foolish and vain. Worldly pleasures and fashions were my only thoughts. I was desperately fond of silks, jewelry, ribbons, laces, automobiles, etc. But, my friends, I soon found that these worldly things were dragging me down to perdition. So I gave them all to my dear mother-in-law."

Coming to the Point.

Doctor (politely, but looking at his watch with visible impatience): "Pardon me, madam, but my time is not my own. You have given me all your symptoms in sufficient detail, and now, perhaps, you will kindly [illegible]"

Husband (not so considerate): "Maria, he doesn't want to hear your tongue any more, he wants to look at it."

One of the Jury.

"Gentlemen of the jury," said the prosecuting barrister, "this prisoner is an unmitigated scoundrel; he acknowledges it. And yet, thanks to the wisdom of the common law, he has been given a fair trial by twelve of his peers."

"Speakin' of mixtures," said Old Jerry as he refilled his jimmy pipe, "I've never used a cooler mixture than flake graphite and oil.

"In the old days," continued Jerry, "when 689 was the fastest engin' on the road, the boys used to wonder why it was never laid up in the tinker's shop an' why it never broke a schedule. 'Fine ole engin', Jerry,' they used to say. 'Nix, flake graphite,' I says. And takin' an old Dixon ad from my pocket I read: 'Write for

"GRAPHITE PRODUCTS FOR THE RAILROAD"

and Sample No. 69.' (You see I didn't mind givin' away the dope.)

"And, Judgin' by the way Dixon's Flake Graphite is bein' used nowadays, every mother's son of them, an' their friends, must have wrote for that booklet and sample."

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RAILROAD NOTES.

The Great Northern is in the market for about 3,200 cars.

The Cincinnati Northern is in the market for 5 locomotives.

The Colorado & Southern is inquiring for prices on 2,000 center sills.

The United Fruit Company is in the market for 30 to 35 freight cars.

The Grand Rapids & Indiana is in the market for six coaches and a mail car.

The Chicago, Burlington & Quincy is said to be inquiring for 55 locomotives.

The Missouri, Kansas & Texas is said to be in the market for ten locomotives.

The Richmond, Fredericksburg & Potomac is in the market for six all-steel passenger coaches.

The Southern has ordered 4,000 tons of rails from the Tennessee Coal, Iron & Railroad Company.

The Eureka Nevada has ordered a Prairie type locomotive from the Porter Locomotive Works.

The Toronto, Hamilton & Buffalo is in the market for fifteen 30-ton steel underframe stock cars.

The French Government has ordered 100 locomotives from the Baldwin Locomotive Works, it is said.

The Long Island has placed an order with the Standard Steel Car Company for 20 steel passenger cars.

The Boston & Maine has placed an order for 15,000 tons of rails with the Lackawanna Steel Company.

The Atchison, Topeka & Santa Fe has ordered 3,000 freight cars from the American Car & Foundry Company.

The Grand Rapids & Indiana, it is said, has ordered five locomotives from the Lima Locomotive Corporation.

The Chicago, Burlington & Quincy has placed an order for 15,000 tons of rails with the Illinois Steel Company.

The Servian Government, it is said, has ordered seven locomotives from the American Locomotive Company.

Formal distribution of 160,000 tons, the remainder of the Pennsylvania rail order, still appears some weeks distant.

The Chicago, Burlington & Quincy is in the market for 1,200 box cars, 300 stock cars and 200 gondola cars.

The Illinois Central has placed an order with the Lima Locomotive Corporation for fifty Mikado locomotives.

The Delaware, Lackawanna & Western has ordered five postal cars from the American Car & Foundry Company.

The Southern Pacific has placed an order for 30,000 tons of rails with the Tennessee Coal, Iron & Railroad Company.

The American Car & Foundry Company has taken the contract for 1,000 refrigerator cars for the Illinois Central.

The Louisiana Railway & Navigation Company has ordered three ten-wheel locomotives from the Baldwin Locomotive Works.

The proposition to construct a new union terminal at Pasadena, Cal., with an expenditure of $3,000,000 is said to be well under way.

The Indianapolis Union has asked for bids on 20,000 tons of structural steel. This will be used in track elevation at Indianapolis, Ind.

The Lehigh & New England has ordered 500 tons of structural steel for its new shops at Pen Argyl, Pa., from the American Bridge Company.

The Baltimore & Ohio has ordered 9,000 tons of standard steel rails from the Cambria Steel Company and 4,000 from the Maryland Steel Company.

The Nashville, Chattanooga & St. Louis is in the market for 10 Mikado-type locomotives for freight service and 6 locomotives for passenger service

The Illinois Central is reported to have just placed an order for 1,000 refrigerators with the American Car & Foundry Company. The same company also has taken six mail cars.

It is rumored in certain quarters that between 20,000 and 30,000 cars will be ordered early this year by the Pennsylvania Railroad and Pennsylvania Lines West of Pittsburgh.

The city of Macon, Ga., and the Central of Georgia have signed an agreement for new $1,500,000 depot and terminal. Railway will start work as soon as it can dispose of its bonds.

The Cleveland, Cincinnati, Chicago & St. Louis, which some time ago ordered 10 switching locomotives from the Amer-

ican Locomotive Company, has recently increased the order to 13.

The Southern has commenced the installation of an interlocking plant at Empire, Ga., where the tracks of its Atlanta division cross the tracks of the Wrightsville & Tennille Railroad.

The Atlantic Coast Line has let contract to the Empire Construction Company, of Douglas, Ga., for brick and carpenter work on proposed shop additions and improvements, at Waycross, Ga.

Orders for rails actually placed by the New York Central lines for early 1915 delivery total 57,500 tons to date, with reservation made at the mills for May, June and July rolling of 13,500 additional tons.

Grand Trunk Railroad officials announce their intention to ask 14,000 of the employes in Canada and the United States to accept a decrease in wages April 1, if traffic receipts continue to decrease.

The New York, New Haven & Hartford, it is said, has placed the following orders for rails: 8,500 tons to the Pennsylvania Steel Company, 7,500 tons to the Bethlehem Steel Company, and 2,000 tons to the Lackawanna Steel Company.

The Canadian Railway Commission will be asked by Canadian railroads for permission to increase freight rates throughout the Dominion, if increases now being asked because of changes in United States railroad rates be granted.

The Pennsylvania has ordered 68 all-steel passenger and baggage cars from its Altoona, Pa., shops of the following classes: Forty-eight class P-70, passenger cars; eight class M-B-M, baggage mail cars for steam service; two class M-B-M passenger mail cars for electric service, and ten class B-60.

The trustees of the Boston & Maine [illegible] of the proposed bill by which legislative authority is asked for the merging of the company and the thirty-six lines it operates under lease. The plan also provides for the elimination of the New York, New Haven & Hartford [illegible] in Boston and Maine affairs.

The State Public Utility Commissioners, of New Jersey, have acted favorably upon application of city for abolition [illegible]. The estimated cost is $2,000,000. No date has been set for beginning the work. The Erie is also contemplating extending its yards at Marion, Ohio, and installing additional machine shops.

Water Power for Railways.

The electrification of the lines of the Chicago, Milwaukee & St. Paul Railway in Montana, Idaho, and Washington is the most important and extensive project of the kind ever undertaken in this country. The change is expected to save at least a fourth of the cost of operation and greatly to better the service in the mountainous parts of the road. The 113 miles in Montana between Three Forks and Deer Lodge on the Puget Sound line of the railway will probably be the first electrified. By 1918, electricity will be the power in use on four engine divisions that extend from Harlowton, in Montana, to Avery, in Idaho, a distance of about 440 miles; and the company is planning to continue the electrification so that it will reach from Harlowton to Seattle and Tacoma, 850 miles away.

The road will get its current mainly from seven water-power plants that can produce about 100,000 horse power. The cost will be only a little more than five mills a kilowatt hour. Twin overhead trolley wires will convey the current to the 260-ton locomotives, which will have a continuous capacity greater than that of any steam locomotive or any electric locomotive heretofore made. When the entire 440 miles is electrified it is expected that sixty locomotives can handle the normal traffic, instead of the eighty-two that are now required.

That will be the first time that electric locomotives have been used on tracks that extend over more than one engine division, and it will give the first good chance to test the advantages of electric railway traction. Under the new system the railway will not need to haul coal and to keep up coal yards and water tanks. There will be no more delays for taking on coal and water, or repair bills owing to poor coal and bad water; and the danger of forest fires caused by sparks from the locomotive will be at an end.

The waterfalls of the Rocky Mountains and the Cascades can furnish, it is said, power enough to run every mile of railway west of a line drawn north and south through the center of the state of Montana, and north of a line drawn [illegible] the southern border of Utah to the Pacific coast. Four great hydro-electric companies in Colorado, Utah, Idaho and Montana, are already equipped to furnish power for enormous electrification enterprises, and it is probable that within the next few years not less than ten thousand miles of mountain railways will be electrified.

"Why, Willie," said the teacher, in a pained voice, "have you been fighting again? Didn't you learn when you are struck on one cheek you ought to turn the other one to the striker?" "Yes'm," agreed Willie, "but he hit me on the nose, and I've only got one."

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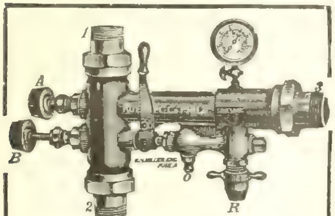

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Books, Bulletins, Catalogues, Etc.

Telephone Handbook.

It is amazing how few people know anything about the internal mechanism of the telephone. Like the human ear all the average man knows is that it is there, and fulfils its mysterious function. Frederick J. Drake & Co., of Chicago, Ill., has published a handbook by Professor David Penn Moreton, of the Armour Institute of Technology, on the subject of the telephone, adapted for practical men. It is divided into ten chapters. The book extends to 286 pages and is fully illustrated. Anyone who reads this book carefully will master every detail of the wonderful invention that has revolutionized the problem of intercommunication by telephone. The style is clear and engaging, the letterpress excellent, the binding substantial, the price one dollar.

"Kewanee" Union.

The National Tube Company has issued an interesting circular explanatory of the merits of the "Kewanee" Union. As its name implies, this union has a male and a female end with particular advantages in the fact that the connection is made between the iron ring and the brass thread end, which prevents corrosion so that the union can be connected, disconnected and reconnected indefinitely. Other unions, as is well known, can be pounded out of shape and made useless in the efforts to disconnect them, and after short service are made useless. The joint also being brass to iron ball, joint seat makes an absolutely air-tight seal without using a gasket. The unions are all submitted to a compressed air test and are guaranteed. They are made in several different patterns, and their great and growing popularity is the best proof of their fulfilling the requirements of reliable unions. Copies of the circular will be mailed to any address on application to the company's office, Frick Building, Pittsburgh, Pa.

Safety Appliances.

An important addition to railroad literature appears in the form of a pamphlet of 111 pages, and entitled "United States Safety Appliances for All Classes of Cars and Locomotives." It is published by Gibson, Pribble & Co., Richmond, Va., for the Master Car Builders' Association, and contains twenty-six separate orders issued by the Interstate Commerce Commission in the matter of designating the number, dimensions, location and manner of application of certain safety appliances, and is the result of the work of the commission under the third section of an act of Congress approved April 14, 1910, entitled "An Act to supplement an act to promote the safety of employees and travelers upon railroads by compelling common carriers engaged in interstate commerce to equip their cars with automatic couplers and continuous brakes and their locomotives with driving-wheel brakes, and for other purposes, and other safety appliance acts, and for other purposes," it is provided, among other things, "That within six months from the passage of this act the Interstate Commerce Commission, after hearing, shall designate the number, dimensions, location, and manner of application of the appliances provided for by section two of this act and section four of the act of March second, eighteen hundred and ninety-three, and shall give notice of such designation to all common carriers subject to the provisions of this act by such means as the commission may deem proper, and thereafter said number, location, dimensions, and manner of application as designated by said Commission shall remain as the standards of equipment to be used on all cars subject to the provision of this act, unless changed by an order of the Interstate Commerce Commission to be made after full hearing and for good cause shown."

The illustrations have been carefully revised by the Committee on Safety Appliances and are believed to be in conformity with the requirements of the United States Safety Appliance Act. The book is issued by authority of the Executive Committee. The price is 25 cents per copy, and orders for any number of copies may be sent to Mr. Jos. W. Taylor, secretary, 1112 Karpen Building, Chicago, Ill.

American Railroads.

An admirable address was delivered by Mr. Howard Elliott, president of the New York, New Haven and Hartford Railroad Company, to the Alumni Association of the Massachusetts Institute of Technology, in Boston last month, and is now published in pamphlet form, and is well worthy the attention not only of railroad men but of all interested in the economic questions of the day. Mr. Elliott claims that American railroads are the most efficient in the world and furnish more and better service and at lower prices than can be obtained in any other country. They are not as good as they should be and can be, but they are owned and managed by human beings who are no better or no worse as a whole than the general public they are trying to serve. They have made, and will continue to make, mistakes, just as people do in all other kinds of business, as well as in government. One reason why they are not as good as they ought to be is that legislators, State and National, in trying to

correct mistakes which owners and managers have made, have allowed the sixpence of errors to blind them to the dollars of wonderful work already done and being done every day. They have, in their efforts to correct abuses and mistakes which were gradually correcting themselves, created conditions which today make it almost impossible for the owners and managers of railroads to go ahead and do the very things which the public wants them to do and that the owners and

Oil Fuel for Steam Boilers.

The McGraw-Hill Book Company has just published another of the interesting series, called the Power Handbooks, which is frequently referred to as the best library for the engineer and the man who hopes to be one. The purpose of the volume is to describe the underlying principles in the use of oil as a fuel for steam boiler practice. The construction and operation of various types of burners, together with their arrangement in different boilers and the operation of pumps, heaters, etc., are described clearly and in many cases by excellent drawings. No special reference is made to locomotive practice as the subject matter is confined to stationary boilers. The book is the work of Mr. Rufus I. Strohm, an eminent engineer, and is sold at one dollar per copy.

Graphite.

The Joseph Dixon Crucible Company after capturing the entire mechanical world insofar as the use of graphite as a lubricant is concerned, continues very easily to hold its own. This reminds us of the story:

A regiment of regulars was making a long, dusty march across the rolling prairie land of Montana. It was a hot, blistering day and the men, longing for water and rest, were impatient to reach the next town.

A rancher rode past.

"Say, friend," called out one of the men, "how far is it to the next town?"

"Oh, a matter of two miles or so, I reckon," called back the rancher. Another hour dragged by, and another rancher was encountered.

asked him eagerly.

"Oh, a good two miles."

A weary half hour longer of march-

"Hey, how far's the next town?"

"Well," sighed the optimistic sergeant, "thank goodness, we're holdin'

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Jersey City, N. J., and you will see that, like Alexander, they are looking for new worlds to conquer.

Failure.

Among Mr. Carnegie's innumerable Scotch stories is one about a caddie of St. Andrews.

This caddie's wife—so Mr. Carnegie's story runs—was much troubled by her husband's loose way of life. He could never have a good day on the links but he must end it with a wet night at the tavern. So, to cure him, the woman lay in wait on the road one evening, dressed in a white sheet.

When her husband appeared she rose from behind a hedge, an awful white figure, with outspread arms.

"Who the deil are you?" asked the intemperate caddie.

"I'm Auld Nickie," said the figure, in a hollow voice.

"Gie's a shake o' yer hand, then," said the tipsy caddie. "I'm married tae a sister o' yours. She'll be waitin' for us up at the hoose, and nae doot she'll

Not Caught Up.

A man who was traveling the Ozark Mountains on horseback, stopped before a typical Arkansas farmhouse to inquire the way. "What's the news?" asked the mountaineer, as he leaned his lank frame against the fence and pulled his long beard thoughtfully.

On finding that what had become a part of history was news to him the traveler asked why he did not take some weekly or monthly periodical that he might keep in touch with the world at large.

"Wal," said the old native, "when my pa died, nine years ago, he left me a

Detective Work.

Scene, village Sunday school. Clergyman questioning a lot of small boys in a farming district.

Clergyman—How did Jacob know that it was Joseph sending for him from Egypt?

name on the wagons.—Tit-Bits.

The Old, Old Cure.

his young hopeful reading a dime nove

"Unhand me, villain," the detected boy thundered, "or there will be bloodshed!"

"No," said the father grimly, tightening his hold on his son's collar. "Not blood-shed—woodshed."

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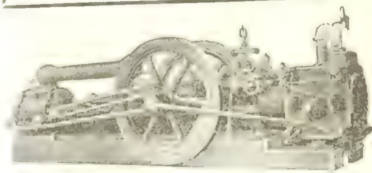
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Vol. XXVIII. 114 Liberty Street, New York, April, 1915. No. 4

New Double Track Vertical Lift Bridges Crossing the Calumet River, South Chicago, Ill.

Last year the Pennsylvania Company completed the second of a pair of Waddell & Harrington double track vertical lift bridges over the Calumet River at South Chicago, Illinois, the first having been completed the previous December. These bridges replace a double track centre pier swing span, providing two additional tracks, and were made necessary by reason of the straightening and widening of the channel by the United States Government, and also by reason of the raising of the grade of the tracks in accordance with the Track Elevation Ordinances of the City of Chicago.

The channel at this point is 140 feet in width and makes an angle of 50 degrees with the center line of the tracks. A clear headroom of 22 feet in the closed and 120 in open position is provided above the water line. The two bridges are alike; each consists of a riveted truss span 210 feet center to center of end posts, the trusses being 36 feet in depth between chord centers, and spaced 31 ft. 3 ins. center to center with a distance of 6 ft. 0 ins. between the centers of the adjoining trusses of the two spans; and two towers one at each end, which are 31 ft. 3 ins. wide by 41 ft. 0 ins. long and about 165 ft. 0 ins. in height from the masonry to the center line of the sheave bearings.

At each corner of each tower is a built-up sheave 15 feet in diameter. These sheaves are set directly over the tower columns and serve to carry the counterweight cables. The latter are of plow steel, 2⅛ ins. in diameter, there being twelve cables for each corner of the span. These cables are fitted with sockets which are connected to the top of the end posts of the span and secured to the steel framework of the counterweights in similar fashion. The counterweight consists of three concrete blocks at each end, each being 46½ ft. in length by 2 ft. in width by 19 ft. in depth and weighing 150 tons. These blocks are joined together at the top by links and are fastened to the cables by equalizers which maintain an even tension in the cables.

[illegible] VIEW OF [illegible] VERTICAL LIFT BRIDGES OVER [illegible]

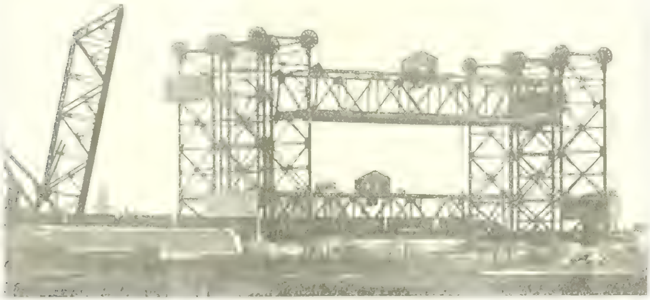
The operating machinery is located at the center of the span on top of the trusses and is protected by a steel framed house with walls of metal lath and plaster. The bridges are operated by two 400 horsepower motors geared to four drums located directly over the top chords of the trusses. On each drum are wound two one-inch steel cables which pass over

[illegible] the end [illegible] top and [illegible] columns, the winding on the drum being such that as one cable is wound on, the other is released. The controller and brakes are located in a cab situated beneath the floor of the machinery house, and the wiring is so designed as to permit the operation of either span from the other. Direct current of 240 volts is supplied from a storage battery of 120 cells located near the bridge and is conveyed to the lift span [illegible] makes a sliding contact with a copper rail secured to the face of one of the tower columns.

The substructure consists of six concrete piers on each side and an abutment which serves to retain the fill. The piers are 14 ft. x 30 ft. with semi-circular ends and extend from approximately 18.0 ft. above the water line to solid rock at an elevation of 70 ft. below water line. The piers are connected at the top by reinforced concrete struts 4 ft. x 8 ft. in section. The abutments rest on 20 ft. piling driven to hard pan and cut off about [illegible]

During the greater part of the time of construction, railroad traffic was detoured [illegible] & Michigan Southern Railway. The spans were erected in the open position on falsework, it being impossible to close the river channel during any part of the year. The substructure was placed by the Dravo Contracting Company of Pittsburgh, and the superstructure by the Kelly-Atkinson Construction Company of Chicago, being fabricated by the Pennsylvania Steel Company of Steelton, Pa. The general work was under the charge of Mr. R. Trimble, Chief Engineer M. of W., the bridge work under Mr. J. C. Bland, Engineer of Bridges, and Mr. T. M. Bole was Engineer in charge of the construction.

In the past few months the variations in weather and the growing amount of heavy traffic have thoroughly tested the structure to the complete satisfaction of the constructing engineers.



[illegible] THE CALUMET RIVER [illegible] LOWERED [illegible]

Statistics of Railroads in the United States.

The most recent completed statistics of the railroads in the United States shows that the total number of persons on the payrolls on the roads was 1,848,883, or an average of 743 for each 100 miles of line. Wages and salaries in one year amounted to $1,373,830,589. There were 369,579 miles of track, with 63,378 locomotives in service, of which 14,396 were used in passenger service, and 37,924 in freight service, the remainder being employed in yards and in miscellaneous service. There were 2,445,408 cars of all classes, of which 51,700 were in passenger service, and 2,273,564 in hauling freight, the remainder being in the service of miscellaneous companies.

The number of passengers carried during twelve months was 1,033,679,680. The roads carried 2,058,679,680 tons of freight during the same period. The average receipts per passenger was 2.008 [illegible] 729 cent a mile.

The revenues derived from operation were $3,125,135,798, and the operating expenses were $2,169,968,924. Of the total capital stock outstanding, $2,836,023,744, or 32.94 per cent., paid no dividends during the year. The dividends paid upon the remainder of the total capital stock outstanding amounted to $368,606,327, which was equivalent to 6.38 per cent upon the dividend paying stocks.

Safety on the Baltimore & Ohio.

[illegible] paign conducted by the Baltimore and Ohio system during 1914 a report issued by the general safety committee shows that 91 per cent. of all items recommended to improve safety conditions was disposed of by the company. Recommendations totaling 9,256 items were [illegible] of safety committees on 23 divisions throughout the territory served by the railroad. The report shows that on no division of the system did the percentage of recommendations adopted during the year fall below eighty. On several of the divisions fewer than ten cases remain to be disposed of, which means that the company recognizes the qualifications of its men to pass upon conditions surrounding their personal safety as well as the safety of passengers.

National Transcontinental Railway.

The total track mileage of the National Transcontinental Railway is as follows: Main line, Moncton, N. B., to Winnipeg, Man., 1,803.42 miles; second track and line from Quebec to site of Quebec bridge, 20.79 miles; sidings and yards, 423.26 miles; total track mileage, 2,247.47. The total cost of the line, as stated in the ninth annual report of the commissioners, was $142,967,999.02, which does not include interest on capital expenditure, nor any expenditure made by the government on the approaches to the Quebec bridge, before that work was taken over as a part of the N. T. R. undertaking. At that date the steel bridges on the line were 97.2 per cent. completed, the Quebec bridge being regarded as a separate undertaking. Since the date of the report, the bridge work has been practically finished, and the other finishing up work has been practically completed. The fitting up of the shops and the provision of other equipment for operation is being proceeded with.

Australian Railways.

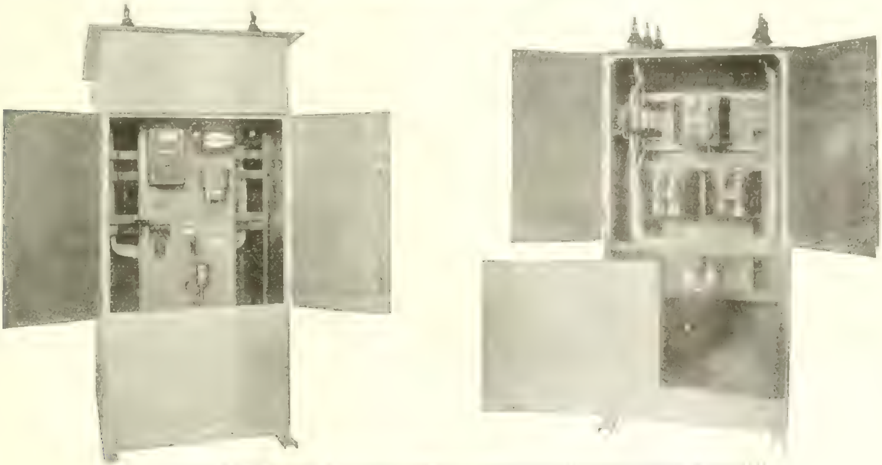
According to a report issued by the high commissioner for Australia good progress is being made in the construction of the Transcontinental Railway, which is to link up the railways of Western Australia with those of the eastern states. It is anticipated that still further progress will be made in the current year. At the West Australian end the head of the road now stands at 152 miles; the earthworks have been completed to the 157th mile, and the telegraph line to 148 miles, 18 miles having been erected during the month. In the South Australian section the head of the road has reached 156 miles. The earthworks extend to about 160 miles, and the telegraph line to 149 miles, 16 miles having been erected during one month. At the western end there are some 638 men employed, and at the eastern end 1,432 men. The total number of miles of line laid is 308. This is exclusive of a considerable mileage of sidings, yards, etc. At the head of the road on the eastern end 150 scoops are at present working in one gang. Good water has been struck in the South Australian section, and boring for water is being continued at both ends in advance

of construction. One large reservoir dam is almost finished in the eastern section, and two others are under construction, and also one in the western section. The news of the Pine Creek-Katherine River Railway, in the northern territory, is that the clearing has been completed for about 35 miles, the earthworks for 9 miles, and the waterways for 11 miles, some 228 men being employed. Rails and other material are now being landed at Port Darwin.

Rural Substations in Railway Signal Work.

The field of application of the rural substation is constantly broadening as its merits become better recognized. The main features are, of course, mobility, ease of installation and low initial cost as compared with a permanent indoor substation of like capacity to accomplish the same result. These points often exert a weighty influence on the solution of the problem of electricity supply, especially when the probable revenue is somewhat speculative, or the need for power either temporary or seasonal. In other cases the question of cost does not determine the installation itself, but merely its character. The accompanying illustrations show views of the first outdoor type steel switch houses of this class built for railway signal purposes, and are used in this connection by the Southern Railway at Inman, S. C., and Austell, Ga. The outdoor substations, of which the switch houses are a part, effect a considerable saving in outlay as compared with what would have been the cost of a substantial permanent substation to house the equipment. Each house is located at the foot of a pole tower supporting the transmission line, the outdoor power transformers, disconnecting switches, choke coils and lightning arresters.

The equipment of the switch houses is a litte more elaborate than usually required for power or lighting purposes. The ordinary house, such as exhibited at the Railway Appliance Association Exhibition last month, has merely an oil switch, or an oil switch and watthour motor, with the necessary current and potential transformers. In the house illustrated, there are also an extra potential transformer, a voltmeter, a circuit closing relay, two potential receptacles, and an incandescent lamp with bracket. The extra transformer, two potential receptacles and voltmeter in connection with other two potential transformers required for the watthour motor, allow the voltage to be read on both sides of the oil switch before it is closed. The incandescent lamp gives illumination at night for reading the voltage or for lighting the inside of the house. The circuit closing relay is used in the usual manner to trip the oil switch in case of overload or short circuit.



RURAL SUBSTATIONS IN RAILWAY SIGNAL WORK ON THE SOUTHERN RAILWAY.

Equipments of this kind are now being built by the General Electric Company. The houses are shipped wired complete, so that the only construction work necessary to put them in commission is to place oil in the oil vessels and connect the incoming and outgoing leads to the roof bushings.

Efficiency Tests on the Pennsylvania.

From a report just issued it appears that out of 3,861,962 efficiency tests and observations made on the Pennsylvania Railroad last year, more than 99.9 per cent. showed perfect obedience to the train safety rules. To be exact, the safety regulations were followed to the letter 1,494 times in every 1,495 cases observed. The tests covered the work of both officers and employes of the operating department. Exactly 24,798 tests were made of the observance of stop signals, and in only 34 cases did the employes fail to live up to the strict letter of the rules—in other words, the employes were 99.86 per cent. perfect in their observance of stop signals. An absolutely perfect record was made by enginemen in observing flagmen's signals; 18,203 tests showed not one failure. Altogether, tests were made last year of compliance with 37 different classes of safety rules. In 31 of the 37 classes, records of 99.9 per cent. efficiency, or better, were made. In three classes, representing a total of 31,379 individual tests, perfect performance was recorded.

Railway Prospects in China.

China already has almost 6,000 miles of railway opened to traffic, with over 2000 miles under construction. Before the appearance of the Chinese National Railway Corporation of Dr. Sun Yat Sen the railway program of the country covered projects aggregating more than 8000 miles, and, without reference to Dr. Sun's plans—which, with the political disturbances in the summer of 1913, collapsed with the cancellation of Dr. Sun's powers by the provisional president of China the new projects outlined in this report cover almost 5,000 additional under foreign agreements.

When it is considered that, practically without important exception, the big railway projects now proposed for China are to be built with foreign capital, the outlook for activity in construction in the near future is not bright, in view of the European war, which involves every European nation having railway concessions in China.

Answers to Air Brake Questions

Their Full Meaning and Significance Should Be Explained

By WALTER V. TURNER

Assistant Manager, Westinghouse Air Brake Company

Sometime ago I saw a short article published in RAILWAY AND LOCOMOTIVE ENGINEERING calling attention to someone having misquoted a statement of mine. This misquotation consisted in one part of my complete statement having been used which permitted the drawing of an inference directly opposite to that stated in the complete statement. I felt under great obligation to you for making this correction on the one hand, and for warning all readers on the other, to be on the lookout for incomplete or garbled quotations, as very serious harm results from such partial statements no matter whether they be accidental or intentional. Often times these misquotations are brought about by a desire to abbreviate the full statement, since to answer an air brake question so that it may be comprehended by the interrogator or student requires many words, in fact, I have said many times recently that I know of no air brake question that can be answered in an explanatory manner in less than an hour, and I am becoming more convinced of this as every day goes by. The chief reason for this seems to be that so few study the science from a fundamental principle standpoint. They endeavor to comprehend the science (that is, the operation and result) by considering, *not what causes the action of the mechanism, etc., but the action itself.* Needless to say no such man has an anchor for his convictions, and thus he is like a ship without a rudder in a storm, tossed this way and that with every opinion or belief when a change in conditions bring about a change in the action; that is, a different operation or result. What is purely due to change in conditions is thought (?) to be due to a freak of principle (miracle) or fault in design.

Obviously any question relating to air brakes that deals with fundamental principles can have only one answer, either "yes" or "no," but almost every question asked on air brake *can* be answered either "yes" or "no," both answers being correct until the conditions are stated, that is to say, under a certain set of conditions [illegible] under another set of conditions "no" [illegible] conditions and not the question itself that determines what answer should be [illegible] tion is put as though it was one of principles and not of conditions. What a great service we could render to the art and science of braking if we could get our fellow laborers in this field to comprehend and employ this distinction.

The immediate cause for writing this letter to you is that it has recently come to my knowledge that another statement of mine has either been misunderstood or misquoted. This is in regard to undesired quick action. I have said many times and repeat that "Undesired quick action from the cause that produces it in some types of brake mechanism, is impossible in some other types." To one who understands the chief underlying cause of undesired quick action, a mere inspection of the design is sufficient to verify this statement. The chief cause of undesired quick action is excessive resistance to slide valve movement, which, however, is more or less likely to cause undesired quick action according to whether many or fewer contributory causes exist at the same time. The peculiarity of this cause of undesired quick action, is that it is undiscoverable, as it is not due to any mechanical defect or any lack of care or maintenance, but arises because of the existence of certain conditions impossible to eliminate. Where quick action is in no way tied up with or dependent upon the operation of the service parts, in fact, where the quick action parts do not even operate when service application is being made, it is evident that undesired quck action can not occur because of the resistance of the [illegible] become greatly increased. It is self-evident that making this statement is not the same as saying undesired quick action is impossible, for as long as quick action is employed, it is plain that the device may become mechanically defective or subjected to such unfair usage in repairs, etc., as to operate quick action when not desired; but obviously this is very, very unlikely and is a visually discoverable defect, while what caused undesired quick action with other apparatus is not so discoverable. It seems strange that we should have to point out this distinction and that a statement should not be construed to mean that which is ridiculous when a perfectly sensible construction is possible, to say nothing of its being plainly meant. However, to make such a misconstruction or misrepresentation of the statement impossible it can be made a little more wordy, viz. "In some devices undesired quick action can not be caused by excessive slide valve resistance (which is the most prolific cause of undesired quick action) and when it does occur is visually undiscoverable; however, with any quick action device, undesired quick action is possible but obviously can only occur, where it is not normally affected by service reductions from a visually discoverable defect, thus undesired quick action is not probable, but only possible, with this possibility reduced to a negligible quantity, since it is evident that uniformity of construction is the rule and not the exception."

You will see what a long statement this runs into in the endeavor to make what is meant clear, that is, to supply understanding as well as information. Even with this lengthy statement, I am not quite sure that it is free from danger of misquotation or misapprehension, but its meaning certainly is obvious, and since this is so, any one who desires may formulate it into a statement which best conveys to his mind its meaning. I rather incline to epigrammatical statements for a starter on any subject, because they have the virtue of arousing opposition and also of creating discussion, which two things are vitally essential to the success of any new endeavor or to the bringing about of any change in the existing state of things. As an example, I am often asked in what distance can a train be stopped from a speed of 60 m. p. h. This is asked without any idea that about a hundred factors or conditions should be included in the question. Without these being given the answer to the question is, "Anywhere from 300 ft. up to 30,000," and one can imagine conditions where the stop would be outside of even these limitations. My answer to the question generally is "Tell me the conditions and I will tell you to a millionth part of an inch what the length or distance of stop will be." Many people who ask this question look askance, and some of them rather express astonishment at such an answer, considering such accuracy to be beyond the realm of possibility. All I have said, however, is, that action in opposite directions; and reaction are always equal; that two and two make four; that opposing [illegible] have a [illegible] each other, and that the same cause must always produce exactly the same effect under like conditions. The reason I make it the way I do, is to make the condition element or factor stand out so boldly that it will be observed and, incidentally to impress the interrogator with the impossibility of answering a question formulated [illegible] this way. [illegible] when I am

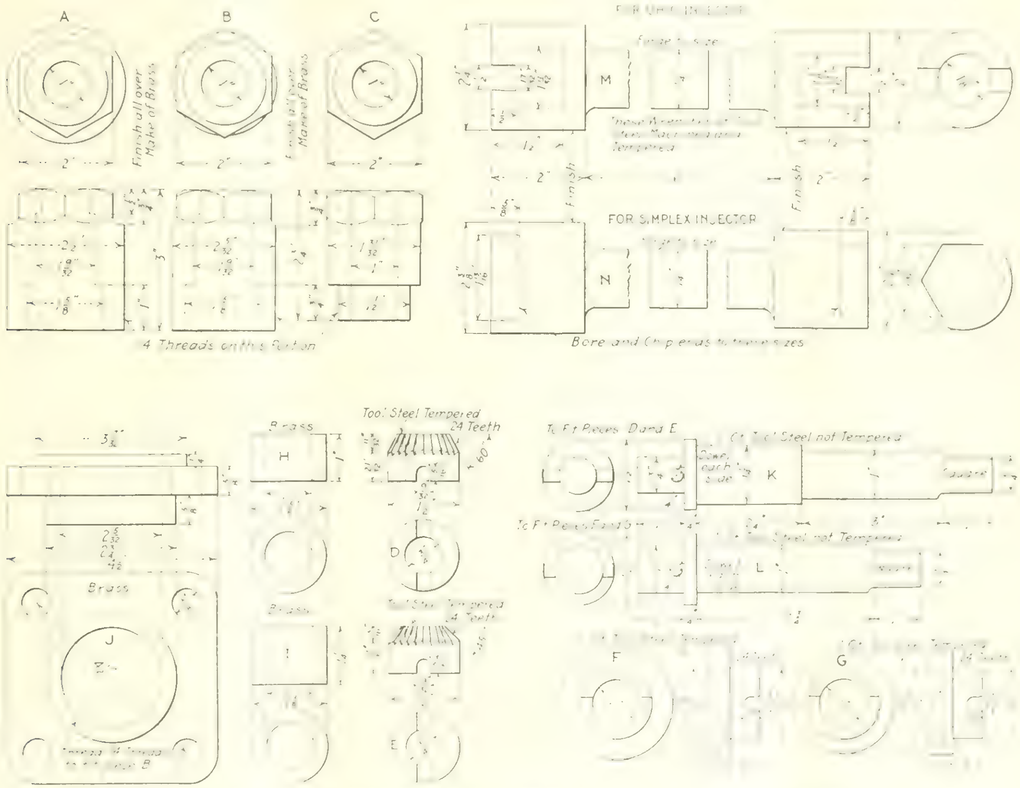
dealing with the physical laws or principles underlying brake results, I make statements of this kind; positive, emphatic and irrefutable. The object being to put the burden of supplying the factors involved in the problem on the questioner and thus getting him to see that the question is very complex and difficult to formulate complete enough for a precise answer to be possible. When dealing with conditions, however, such inclusive and exclusive statements instead of being of few words and epigrammatical as in the other case, are just as prolix, redundant and elaborate as time and patience of the listener will permit, for I recognize that questions or results hinging upon conditions are as different in point and as various in result as are the conditions themselves. Thus once again you see we are back to the consideration of the necessity of recognizing the distinction between principles and conditions, or cause and effect. The one is a matter of quality, therefore can receive an answer; the other is a matter of quantity, the answer to which can seldom, if ever, be complete, and at best can only be relative. This answer must reside, in the last analysis, in the capacity, the understanding and in the competency of the one considering it.

I hope the philosophy and psychology of the foregoing may be of some service to you and those interested in the science and the problems of air brakes and that you will make use of it to this end.

Facing Tools for Injector Repairs

By E. L. BOWEN
Foreman, Illinois Central Railroad

Enclosed are drawings of some tools for facing steam nozzle and steam ram seats for Ohio and Simplex injectors. These tools will handle four sizes of both makes of injectors, that is Nos. 8, 9, 10 and 11. Cutters D and E fit arbor K and are used for reseating steam nozzles for the steam rams. Cutters F and G fit arbor L and are used for facing steam nozzle seats in both makes of injectors. Brass flanged piece J is used with pieces B, H and I to face Ohio steam nozzle seats and is threaded to fit piece B. A wrench should be had, one end to fit hexagon-headed brass pieces A, B and C, and the other end to fit squares on arbors K and L.



DETAILS OF TOOLS FOR FACING STEAM NOZZLE AND STEAM RAM SEATS FOR OHIO AND SIMPLEX INJECTORS

[The sketches] show double-ended wrenches for Ohio and Simplex steam nozzles. The centers are forged square and the ends machined from the solid. They are made of tool steel tempered. The design of the Simplex injector does not permit of a very strong wrench being used, so wrench N is made so it will just go through mouth of injector and ends are bored and chipped from solid to fit hexagon heads of steam nozzles, thus getting maximum strength. This is important, for steam

poor wrenches that slip off and crush them out of shape. From these sketches it will be seen that a minimum number of tools is made to cover the four sizes of both makes of injectors.

Notes and Comments on Locomotive Lubrication

Old Theories and Practices Should Be Carefully Inquired Into

By F. P. ROESCH

Master Mechanic, El Paso & Southern System

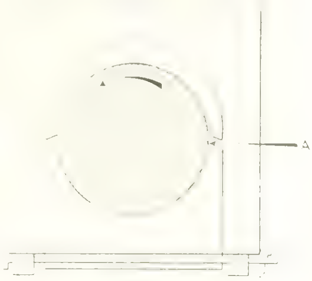
[illegible]

Locomotive lubrication is naturally as old as the locomotive itself, but, regardless of this, it appears that the "whys and wherefores" of locomotive lubrication are as little understood by the average man to whose duty it falls to handle or take care of a locomotive, as it was in the beginning. This may be due to the fact that with the increase in size and general character of the locomotive there has been a change in the methods as well as the materials used in lubrication. And as the young engineer is naturally the product of the teachings of the older man, he, of course, has absorbed some of the ideas and theories of his teacher. Consequently, unless he has made a practice of thinking for himself, or not accepting a theory until proven to his own satisfaction, he will naturally continue the practices in vogue with the man he fired for. The object of this article is to knock out some of the old accepted theories and practices. In other words, to bring the theory and practice of lubrication up to date.

Lubrication, as we are all aware, consists of the introduction of a comparatively frictionless substance between two surfaces which move with relation to one another. The lubricant introduced can be either fluid, semi-fluid or solid, as, for instance, oil, grease or graphite. The primary object, of course, being to reduce the friction between the two moving surfaces to a minimum.

[illegible]

Taking up first the matter of journal lubrication and referring to locomotive driving box journals. With the light engine that formerly obtained, the only lubricant used was oil. This was in the driving box cellar in the shape of saturated or soaked waste; the waste being used on account of its capability of absorbing a certain amount of oil, which oil was brought in contact with the journal by means of the resiliency of the waste and the capillary attraction. In other words, the waste being held in contact with the journal allowed the oil to come in contact also, and by means of the revolving journal, it was carried up between the two bearing surfaces; that is, the journal and the brass, thereby separating the two and reducing the friction. For various reasons the use of oil-saturated waste for [illegible] stead of this, the use of grease was introduced. As we are all aware, the grease is forced up against the journal by means of coil springs attached to a plate upon which the grease rests. A perforated plate, formed to the contour of the journal, is placed on top of the cake of grease in order to prevent a too rapid feed. So long as the plate conforms to the contour of the journal,



this method of lubrication is highly satisfactory, but if this perforated plate once becomes uneven or dented, or has any slight projections above the normal surface, the projection acts as a scraper to scrape the grease away from the journal, leaving that part of the journal dry, with the result that the friction set up by the unlubricated portion of the journal will soon cause heating,

which heat will finally extend to the entire journal and continue until the cause of the heating has been corrected.

The use of grease increases the friction over that which would obtain through the use of oil. This is due to the fact that when the grease is cold its cohesion is greater than oil. At the same time its adhesion to the bearing surface is less, and when the grease is beginning to melt its cohesion is still greater than oil and its adhesion to the bearing surfaces, while greater than when it is in its solid form, is still less than oil. In other words, it is necessary to obtain a certain amount of friction when using grease, to reduce it from a solid to a semi-fluid state, and, consequently, any bearing that is grease-lubricated will naturally run much warmer than one oil lubricated, and as the presence of heat under such conditions indicates friction it is plain that there must be more friction when grease is being used than when oil is being used.

As stated above, the adhesion of grease to a journal is much less than that of oil, consequently some provision must be made to carry the grease up between the journal and its bearing. The usual provision is to cut away the edges of the driving box brass so as to prevent the edge of the brass acting as a scraper, having a tendency to scrape the grease off the journal. The action of the driving box journal in the bearing, however, automatically provides for the grease feed as follows: Referring to Fig. 1, which shows an ordinary driving box and journal: In this instance it is assumed that the rotation is in the direction of the curved arrow shown on the journal; the crank pin is leaving the back center, consequently the direction of the force is as shown by the arrow "A," this force having a tendency to push the journal against the front side of the brass, leaving an opening between the back of the journal and the brass. As the wheel completes its revolution we have the condition shown in Fig. 2. The force in this instance being exerted against the front of the journal, pushing it back so that the grease that was carried up from the rears has now an opportunity to pass entirely around the journal between it and the brass, there- [illegible] It is through this action of the journal in its bearing that grease lubrication is possible, and where such action does not obtain, grease cannot be used. As, for instance, the question is often asked "Why is it not possible to use grease in engine or trailer trucks?" or, in fact, in any other boxes outside of the driving boxes. If, now, you will refer to Fig. 3 the reason will no doubt become plain.

When considering the lubrication of any other journal outside of driving

journals we must not lose sight of the fact that where the driving journals propel the engine, the engine or car, as the case may be, propels all other journals. The movement of all the journals outside of driving journals is produced by the pressure of the brass against the journal, as shown in Fig. 3, and as this pressure is always in the direction of rotation, it is plain that were grease used in this instance the edge of the brass pressing against the journal would act as a scraper to carry off the lubricant. The question may be asked "Why doesn't the brass act in this manner in the case of oil?" The reason of this has been previously explained, in that the adhesion of oil to a bearing is greater under all circumstances than that of grease. Again, there is no journal that constantly remains in intimate contact with its bearing. On the contrary, as a journal revolves, regardless of the amount of weight upon it, there is always an occasional separation between the journal and its bearing, due to either some inequality in the track or inequality in the wheels, and it is during this interval of separation that the oil can readily be carried between the journal and its bearing.

HOT BEARINGS.

Before leaving the subject of journal lubrication it might be well to mention some of the causes of hot bearings. Of course, if the causes are known, the remedy will be obvious. Principal among causes for hot driving journal bearings where grease is used is the poor fit of the perforated plate previously mentioned. Next will come

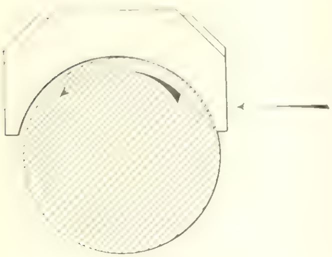


FIG. 3

defect in the brass that will cause a portion of the brass to act as a scraper, cutting away the lubricant. This may be caused either by the brass having become heated at some time and then closed so as to pinch the journal, to a crack in the brass, or to the manner in which brasses are grooved out. In this latter or grooving proposition we are taking issue with the practice advocated by the inventors of the grease cellar, but in this instance we believe our position to be well taken and capable of defense.

Fig. 4 is an illustration of the grooving advocated and practiced in many shops. Of course, in this instance, the primary idea is that grease will be carried up into these grooves and from them distributed to various parts of the journal; also, that these grooves tend to act as receptacles or storage reservoirs for grease, which, when the journal becomes warm, will melt and act as a lubricant. That this theory is entirely incorrect is proven by the fact that there is never any grease found in these grooves when a journal is dropped on account of same running hot. On the contrary, the grooves, instead of acting

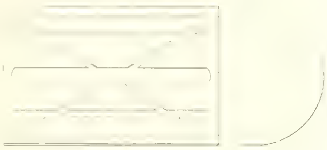


FIG. 4

as receptacles, simply form passages whereby the grease can be carried from one side of the brass to the other without ever coming in intimate contact with the journal at all. The grooves also materially reduce the bearing area, and, last, but not least, every individual groove can, under certain conditions, act as a scraper to scrape away the grease from some one portion of the journal, and thereby set up the condition previously mentioned, which will ultimately result in the heating of the entire journal.

As shown in Figures 1 and 2, there is absolutely no need of this grooving or of this reduction in bearing area. In fact, repeated tests have proven that if the entire bearing area of any bearing, but especially a driving box bearing, be left intact, that much better results will be obtained than by having it cut away with numerous grooves. We have often been tempted to ask the advocates of the grooved bearings why the same system was not adopted in crank pin bearings.

CRANK PIN LUBRICATION.

Modern practice commends the use of grease in crank pin lubrication, same as in driving journal lubrication, for practically the same reasons. As we are all aware, the lubricant, grease, is introduced between the crank pin and the brass in practically the same manner as obtains with the driving box, except in this instance the grease is introduced from above instead of below.

In crank pin lubrication the action of the bearing on the journal is practically the same as in driving journal lubrication, in that with the locomotive moving forward when the piston is pulling, the back half of the main rod brass is forced against the crank pin, while the front half is away from it, thereby offering an opening which allows the grease to be carried between the brass and the pin. As the revolution is completed, the pressure is reversed, and the grease is now carried around, completing the cycle.

In order to have perfect crank pin lubrication conditions should be right. Such conditions usually obtain on side rods where the ordinary round bushing is used, and, therefore, little trouble is ever experienced with side rod bearings running hot. Of course, the fact that each side rod bearing only takes its proportion of the load has considerable to do with their running cool. This fact should also be taken into consideration by those whose duty it is to fit up main rod brasses, so that the condition of the main rod brass or bearing may approach as nearly as possible that of the side rod. This means that the brasses should not only be a good fit on the pin, but also a perfect fit in the strap. As the top and bottom of the main rod brasses occupy the same relative positions, so far as the direction of force and lubrication is concerned, as the front and back sides of the driving box brasses, the tops and bottoms of the main rod brasses should be cut away as shown by the dotted lines in Figure 5, so as to afford an opportunity for the grease to get down on the pin and be carried around as the pin rotates. Unless this provision is made, the edges of the brasses will act as scrapers to scrape the grease off just the same as on the driving box.

HOT PINS.

Ordinarily, the cause of any hot pin [illegible]

FIG. 5

gation. As a rule, however, when pins are reported as running hot the roundhouse man simply takes down the rod reported, and if the brasses all show to be moderately good fit, he does not look further for the trouble, but probably eases the brasses a little at the top and bottom, and puts the rod up again. As the principal trouble obtains in back ends of main rods, we will confine our remarks entirely to this one pin, although the same remedies will apply to other pins under same conditions.

[illegible] a variety of causes, but eliminating such things as lack of grease, abrasives in grease, etc., we will confine ourselves altogether to mechanical defects. Of course, we know that if a brass is keyed so tight as to pinch the journal, it is bound to run hot. The remedy in this case is obvious, namely, slack off on the key. In slacking off on the key, however, care must be taken not to slack off too much, as a

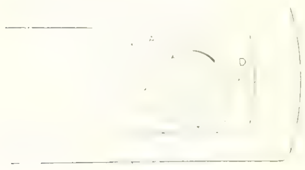


FIG. 6.

loose and pounding brass will run just as hot as one that is a little too tight. This is due to the fact that if the brass is loose enough to pound each time steam is admitted to the cylinder, it will cause the brass to strike the pin a blow whose force is in proportion to the pressure exerted against the piston and the amount that the brass is loose on the pin. Therefore, in slacking off on a key, just slack it sufficient so that the rod can be moved laterally on the pin on all positions.

[illegible] STRAP

This is a matter that does not receive sufficient attention, and yet is the cause of as many hot pins as any other one single item. Referring again to Figure 5, the solid lines show the position of the brass and key, with the brass a perfect fit in the strap. If now the brass is loose in the strap, the key and brass may take the positions shown in dotted lines, and in this case, as can be seen, the top of the front brass and the bottom of the back brass, act as perfect scrapers to scrape the grease off the pin as it rotates. In fact, instead of the grease being forced down through the compression in the cup, this condition has a tendency to force the grease up into the cup or out on each side of the crank pin.

Another condition frequently met with [illegible] all of the figures herein shown conditions are intentionally exaggerated, so as to make the illustration more clear.) Re- [illegible] strap which through neglect and excessive [illegible] has become [illegible] at the back, as shown in solid lines, the dotted lines [illegible] new brass is fitted into a strap under such [illegible] as the back of the brass [illegible]

in the center. As the center of the brass takes the greater part of the strain, it is only a question of time before the brass is broken, as shown by dotted lines. [illegible] a scraper action at each division point, namely, "A," "B," "C" and "D." Consequently, it is only a miracle that prevents a brass under such conditions from [illegible]

Back to the Wood-Burning Days

By HUGH G. BOUTELL
Washington, D. C.

If you ever have occasion to take a trip on the branch of the Southern Railway, that runs from Greensboro to Sanford, N. C., keep your eyes open as the train pulls into the town of Bonlee. You will get a distinct surprise, and if you are interested in locomotives you will be tempted to get off the train right there, or if you can't do that, you will certainly plan another trip with a stop-over at [illegible]

On a track that runs on the other side of the platform from the one you are on is a train, consisting of perhaps a [illegible] rather than the exception, and when each locomotive had its name and was a favorite of all the patrons who lived along that section of the road. The track we have just mentioned is the eastern end of the Bonlee & Western Railway, and the engine represents just fifty per cent. of the motive power of the road.

The Bonlee & Western Ry. was promoted by Mr. John H. Dunlap, a thrifty lumberman of this section, and his brother Isaac. The road was built [illegible] four years ago to connect the towns of [illegible] miles in length, and at the time the line [illegible] ran was practically undeveloped, consisting mostly of woodlands. Mr Dunlap decided that he could buy wood from the people living along the line of his road for less than the price of coal which would have to be bought from outside parties. This would keep the money paid for fuel in the county, and would benefit all concerned. The idea has worked out exactly as expected, two and one-half cords of wood being equal to one ton of coal, leaving a difference of $1.35 in price in favor of wood. Oak is the fuel burned.

As mentioned above there are two locomotives in use on the road. No. 1 was purchased from an Atlanta shop, which partially rebuilt it, and claimed it was once the property of the Southern Ry. It was built by the Baldwin Locomotive Works in August, 1886, and is of the "American" type, with cylinders 15x24 inches, 48 inch drivers, and weighs 35 tons.

No. 2 was purchased from the Norfolk & Western Ry., and was changed from a coal to a wood-burning machine. This engine is shown in the illustration, which shows it up very clearly. As will be seen, the original extension front has been retained, which looks rather odd with the big balloon stack. This engine was also built by the Baldwin Works in 1881, and has cylinders 19x24 inches, 48-inch drivers and weighs [illegible] It was [illegible] Ry. in 1912, [illegible] excellent condition.

[illegible] BONLEE & WESTERN RAILWAY.

Mr. W. J. [illegible] superintendent and traffic manager of the road, takes a lively interest in the old engines, and says that he receives quite a few letters of inquiry concerning them from people passing through the town. He is the one who gave me most of the information contained in this little article, and also offered every facility for taking the picture.

Mechanical and Scientific Notes

Nickel Plating.

Light nickel plating can be accomplished by heating a bath of pure granulated tin, argol, and water to boiling, and adding a small quantity of red-hot nickel oxide. A brass or copper article immersed in this solution is instantly covered with pure nickel.

Welding Steel.

Cast steel: borax 64, salammoniac 20, ferro-cyanide potassium 10, rosin 5. Boil all with some water, constantly stirring until homogeneous compound is formed. Then dry out slowly in same vessel. Welding done at light yellow heat or towards white heat.

Etching Glass.

Coat the glass with melted candle-grease, and draw the pattern to be etched in the wax with a sharp needle point. Then expose the glass to the action of vapor of hydrofluoric acid, generated by acting on fluor spar with hydrochloric acid, and gently warming. The gas must be generated in a lead vessel, as it attacks most substances. It is very poisonous, and therefore care must be taken not to inhale it.

Fireproof Cement.

A good fireproof cement can be formed of iron filings 140 parts, hydraulic lime 20 parts, quartz sand 25 parts, salammoniac 5 parts, and enough of vinegar to make a paste. A similar cement consists of iron filings 180 parts, lime 45 parts, and common salt 5 parts, converted into a paste with strong vinegar.

Soldering.

It often happens, when soldering with killed spirits as a fluid, that the latter cannot be applied thick enough to insure a good joint. Add some starch to the killed spirit, and boil the mixture, so as to make a sort of syrup, and you will find that you can make a far stronger job, especially when soldering up tins which have to stand pressure from within, such as preserve tins, than otherwise. The starch is, of course, turned to charcoal; but this does not hinder in the least, and can be wiped off.

Wiping a Joint.

Open the [illegible] that the other piece of the pipe will just enter, then scrape with a shave-hook to size of joint, taking care to keep it perfectly clean. Fasten the two pieces of pipe securely in position, rub bright parts with a tallow candle, and proceed to pour or splash metal on joint, wiping it into shape with a cloth made of several thicknesses of fustian. You will require a metal pot, ladle, bar of metal, shave-hook, turnpin, soil, tallow, rasp, several cloths, and a deal of patience.

Casehardening.

Yellow prussiate of potash, by weight, 7 parts; bichromate of potash, 1 part; common salt, 8 parts; pulverize the crystals and mix thoroughly. Heat the piece to be hardened to a dark red and dip into the preparation or sprinkle it on the piece. Return to the fire and let it soak, then repeat several times according to the depth of hardened surface wanted. Finally plunge into water or oil. This may be used on tool steel, soft steel or iron.

Hardening a Hammer Face.

To harden hammer face, heat the hammer to a bright red all over, dip the face into the bath about ¾ in., moving it about the surface the while about half a minute, remove from bath and rub the face bright, then dip the nose of hammer about ½ in. till the face has drawn to a deep straw color, then cool the face and draw the nose down to blue, and cool altogether. If done properly a hammer tempered in this way will be right for years.

Bright Whitewash.

Half a bushel unslaked lime; slake with warm water, cover it during the process to keep the steam; strain the liquid through a fine sieve or strainer; add a peck of salt, the same to be previously well dissolved in warm water; add 3 lb. of ground rice boiled to a thin paste, and stir in boiling hot; add ½ lb. of glue which has been previously dissolved over a slow fire, and add five gallons of hot water to the mixture; stir well, and let it stand for a few days, covering up to keep out dirt. It should be put on hot. One pint of the mixture, properly applied, will cover a square yard. Small brushes are best. There is nothing can compare with it for outside or inside work, and it retains its brilliancy for many years. Coloring matter may be put in and made of any shade—Spanish brown, yellow ochre, or common clay.

Making Holes in Glass.

For making holes in thin glass, put a piece of stiff clay or putty on the part you wish to make a hole. Make a hole in the clay or putty equal to the diameter of the hole you wish to make in the glass. Into this hole pour a drop of molten lead and the piece the size of the hole will drop out.

Radium.

If one could utilize the energy of a ton of radium through a space of thirty years it would be sufficient to drive a ship of 15,000 tons, with engines of 15,000 horsepower, at a rate of fifteen knots throughout the whole thirty years. To do this 1,500,000 tons of coal are actually required, says the Chicago *Tribune*.

These are not fanciful figures, for the energy is there, though, as a matter of fact, it is unlikely that man will ever produce much more than half an ounce of radium a year.

Still, the fact is important for this reason—that science is convinced that the radium in radium bromide is not the only element which possesses this marvelous store of energy, but that the calcium in gypsum and the sodium in common salt contain also this energy content.

Fastest Speed Record.

Connected with the great Salt Lake of Utah is a vast expanse of salt deposit that is absolutely level and hard as rock. An automobile race was held on this salt formation recently and, a speed of 43 miles an hour was attained, the highest velocity ever reached by man's invention.

According to one authority the automobile run was made by "Teddy" Tetzlaff on August 12, last, and the best time for one mile was 25.2 seconds, which is equal to 142.85 miles an hour, a trifle better than the best preceding record, which was made on the beach at Daytona, Fla., in April, 1911. This is the highest speed ever traveled by man on the face of the earth. The best speed ever made by a vehicle running on rails was that recorded in the Berlin-Zossen tests of electric cars, in 1903, when a rate of 130.5 miles an hour was made, on October 27. The crystallized salt in this Utah bed makes a hard and absolutely level surface, and it is said that even in the hottest weather it does not heat the tires of automobiles. The salt-beds are 65 miles long and 8 miles wide. The estimated depth, in the middle, is 12 feet to 15 feet. The salt is white and averages 98 per cent. pure. Tetzlaff says that with more preparation he can make still better speed. In racing over the salt-beds the motorist has an unusual feeling of security because of the entire absence of obstructions.

Experience has shown that the end of a bar of steel that has been broken off should never be used for the working or cutting end of a die or punch. The fibres in the end of such a bar have been so severely strained in breaking that the steel is unsuitable for performing the [illegible]

Wireless Telephone in Railway Service

Successful Experiments on the Lackawanna

By J. F. SPRINGER, New York

[illegible] & Western [illegible] under- [illegible] of wireless telegraphic communication be- [illegible] trains and also between trains has now further distinguished itself as the pioneer in developing a similar service with the wireless telephone. There are two trains in the fast express service between New York (Hoboken) and Buffalo. These were [illegible] the road has changed the equipment of one so as to provide for the transmission and receipt of wireless telephone mes- [illegible]

[illegible] with the telegraph that encouraged the recent work. That success has been and is more than those not fully informed may suppose. There are four fixed wireless stations located at Hoboken, Scranton, Binghamton and Buffalo, the intervals in the total of 410 miles being 140, 70 and 200 miles. The telegraphic transmitting capacity from the train is 134 miles. The receiving capacity turns on the transmitting capacities of the fixed stations which are more powerful yet. Accordingly, there is no moment of the trip when the train is out of touch with the fixed stations. There are no ordinary conditions occurring from year's end to year's end that interefere seriously enough to stop communication, except two. There is a tunnel nearly a mile long just west of Hoboken where various electric currents are carried through the tunnel itself by permanent wires. Whether this explains the interference or not, it has been found impossible to communicate by wireless telegraph when the train it within the tunnel. There are two other tunnels on the line between Hoboken and Buf- [illegible] the electric transmission wires are carried on the exterior surface instead of through the tunnel bore. Communication is pos- [illegible] tunnels. With regard to the difficulties hitherto encountered with the Hoboken tunnel, it is expected in time to overcome [illegible] second source of interference experienced [illegible] thunder storm. Apart form the place or the conditions of interference now set [illegible] control of their wireless telegraphic system in a thoroughly practical and efficient manner

There are attractions about a wireless telephone service which appeal to practical [illegible] in operating expense. No attendant is required to travel with the train. The system which is now in use, and which the railroad is extending is so simple in operation that an operator is not required.

A good deal of the apparatus employed is similar to or the same as that employed with wireless telegraphy. Thus the aerials at the fixed stations may be used for either service. So also the aerials on the train are precisely the same or nearly so. [illegible] Buffalo on alternate mornings at 10.15 has strung along on the car tops at an elevation of 1½ feet two No. 10 stranded phosphor bronze wires, one on either side. Iron stanchions fitted with porcelain insulators supply the necessary supports at the four corners of the several cars. The [illegible] Flexible connections join the whole *in series* into a system about 300 feet long. The aerial system thus provided on the coach tops extend but little or nothing at all above the roof itself. The eighteen inches elevation is above the roof decks on either side.

In order to transmit, power is needed [illegible] steam turbine engine set up in the middle of the combination mail and baggage coach which follows the tender. That is the turbine is located in the fore part of the baggage section. The steam is [illegible] supplied normally at 125 pounds to a 5-hp. turbine. The last is direct-coupled with a high-frequency alternator of special design. The exhaust of the turbine opens onto the bed of the track.

The operating conditions for the turbine-alternator are especially severe as it is necessary to throw the full load on and off frequently, and suddenly as the operation of the telephone passes from transmission to receiving and back again. The rotational speed necessary is about 2,500 r. p. m. This angular velocity is maintained with a good deal of exactness by means of a governor of special design. An auxiliary piece of apparatus is the exciter unit, having capacity of ¼ kw., 110 volts. It is set up overhead and is belt-connected to an extension of the alternator's shaft.

The system of wireless telephony used is that of De Forest, which has recently been perfected. In fact it would seem as if railroad conditions themselves limit the choice of a system. Thus, no system which required skilled attention at the transmitter appears admissible, as one of the foremost advantages of wireless telephony over wireless telegraphy consists in the possibility of eliminating the trained operator. In the De Forest transmitter here employed, once the quench spark gap is adjusted, the regulating device is locked up, and requires no further atten- [illegible]

With the new transmitter it is not necessary that "the antenna system be tuned to the primary, nor even be 'substantially in tune' with it." The wave length transmitted may be varied in a simple manner by moving a contact switch operated from the front of the transmitter case. After the person desiring to communicate with the nearest fixed station has once set this switch, he has no further "tuning" to do.

A small light connected with the "lis-

AERIALS ON LACKAWANNA CARS

THE TELEPHONE APPARATUS AT A FIXED STATION

tening switch" indicates whether the latter is set for talking or listening. When it is up, the light is lit, and he may listen to the person talking from the fixed station. When it is down the light is out, and talking may be done.

Transmission is effected by means of an alternating curent of 6,000 cycles. It is brought from the turbine-alternator by a pair of train connectors to the rear end of the coach next following the mail-and-baggage car. In order to provide for the regulation of the voltage and the input of power, two leads are brought into the telephone booth.

The telephone instrument as a whole consists of an upper part devoted to transmission, and of a lower part where are located the tuning apparatus necessary to the receiving arrangements.

Essential parts of the equipment are what are known as the Audion detector and the Audion amplifier. The function of the latter is to intensify the voice pulsations. It is said to be possible with this instrument to secure an intensification of sixty fold. There is no derangement or distortion of the vocal vibrations. Their general qualities are faithfully preserved, but the intensity is multiplied. If it were not for this device it is doubtful whether railroad telephony would now be a demonstrated fact, because without it the train noises would occasion so serious an interference with the reception of messages that the receiving range on the Lackawanna would, so it seems, have been cut down to 10 miles. This would have made the entire system impractical from a commercial points of view. An effective range of 30 or 40 miles has been created by the use of a two-step Audion amplifier. It will be of sufficient interest to warrant the digression to say that it is a form of this device which is now employed in telephonic communication by wire between New York and San Francisco, which has so recently become a [illegible] possibility.

The first trials concerned themselves with the receipt of messages on a train, and not with transmission from it. It was found possible in the preliminary work to transmit from the fixed station at Scranton and receive on the moving station, going east at the rate of 50 miles and more per hour. As far as Stroudsburg, 52 miles from Scranton, the voice of the operator at the latter's fixed station could be discerned.

An official test was made [illegible] ruary when five wireless telephone messages were sent in to the Binghamton fixed station from the moving train as it went past stations to the east and west. Thus, messages went in from points where distances from the receiving point ranged from 8 to 27 miles. It is expected to improve upon these results, and in a short time to have an effective radius of transmission double that disclosed by this trial. It should be understood that the receiving radius is still greater for the reason that the fixed stations are equipped with more powerful apparatus.

It is thought the the wireless telephone offers especially attractive possibilities for service with freight train operation. The estimate is made that it costs the road from $20 to $30 every time a long train performs some unnecessary act. A considerable percentage of these unnecessary moves could probably be avoided if it were continually possible to transmit orders to trains while under way. Leave out of consideration the dispatch of messages *from* the trains. The expense of equipping cabooses with receiving apparatus would not be great. It is conceived that series of small radio telephone stations might be established all along the road, and that orders might be received and transmitted by them. Such transmitting stations could be put into service at a moderate expense. In fact a small transmitter has already been developed which has an effective radius of 2 or 3 miles. The cost is said to be less than $400. It would apparently not be necessary to have stations so thickly scattered that trains would always and everywhere be within telephonic reach. Certain "zones" could be provided within which orders could be transmitted to the trains. There would thus be provided for such transmission the opportunity afforded by the passage of the train along 5 or 6 miles of track. These small stations would receive their messages by wireless and transmit automatically. The equipment in the cabooses could be restricted to the receiving apparatus, thus eliminating the necessity to generate a current [illegible] pense of $30,000, and that the operating expense would not be over $1,000 per year.

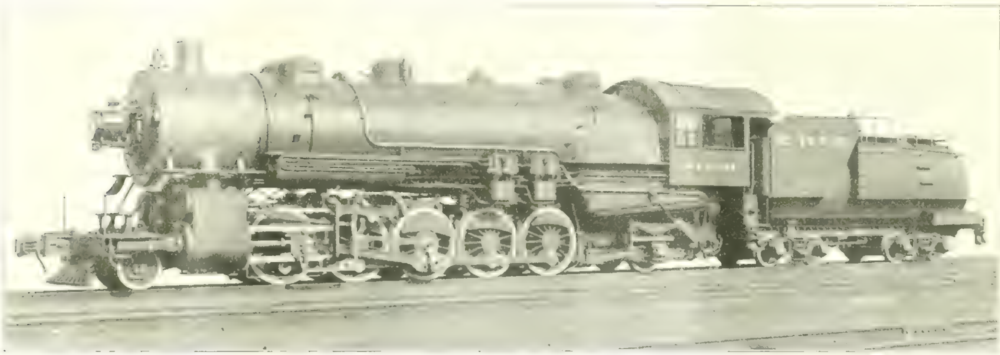
[illegible]

New 2-10-2 Type of Locomotive for the Erie

Latest and Most Powerful Example of the Ten-Coupled Engine

The Baldwin Locomotive Works has recently completed, for the Erie Railroad, a locomotive of the 2-10-2 type, which is slightly heavier than the engines with this wheel arrangement built last year for the Baltimore & Ohio Railroad. The following table gives the leading particulars [illegible]

	Cylinders	Drivers	Steam Pressure	Grate Area	Water Heating Surface	Superheating Surface	Weight on Drivers	Weight Total Engine	Tractive Force
[illegible]	[illegible]	[illegible]	200	88	5,573	1,329	336,800	406,000	84,500
Erie	[illegible]	63"	200	88.1	5,801	1,377	327,250	407,700	83,000



2-10-2 TYPE OF LOCOMOTIVE FOR THE ERIE RAILROAD.

[illegible] Baldwin Locomotive Works, Builders.

The two locomotives are thus of very nearly the same capacity, the dimensions being varied to suit the conditions of service on their respective roads.

The boiler of the Erie locomotive has a conical ring in the middle of the barrel, which increases the shell diameter from 90 ins. to 100 ins. The main dome is of pressed steel in one piece, and is mounted on the connecting ring; while the auxiliary dome is forward of the firebox, on the third ring, and is placed over a 16-in opening in the shell. This boiler has 24-ft. tubes, and a combustion chamber 28 inches long. There is a full installation of flexible bolts in the water legs, and four rows of flexible bolts stay the front end of the combustion chamber crown. The tubes are welded into the back tube sheet. The [illegible] [illegible]heater, Security arch (supported on [illegible] tubes), Street stoker, Talmage ashpan and blow-off system, Franklin grate [illegible] th[illegible]

The cylinder castings are simple and massive in design, and each is secured to its respective frame by twelve horizontal bolts, 1½ ins. in diameter. In designing these cylinders, special attention has been given the exhaust passages, which are unusually direct and of liberal sectional area. The cylinders and steam chests are fitted with bushings of Hunt-Spiller gun iron, and the same material is used for the piston and valve packing rings. The valves are driven by Baker gear; they are 16 ins. in diameter, and are set with a lead of 3/16 ins. The Ragonnet power reverse mechanism is applied. The [illegible] light for an engine of this size. The pistons are of forged and rolled steel, with a Z-section. The guides are of the alligator type, and they have a vertical spread of 20 ins. between bars. The crossheads have cast-steel bodies with bronze gibs, [illegible] light for a crosshead of this type with gibs 32 ins. long. The front and back main-road stubs are of the Markel type, with removable brasses. The cast steel filling blocks in the main stub are cored out to remove as much weight as possible. The combination of relatively light parts, with wheels of comparatively large [illegible] manner, without resorting to the use of auxiliary counterweights on the main axle. It has been necessary to use lead in the counterweights of the main wheels [illegible]

The frames are vanadium steel castings, with rear sections of forged iron. The main frames are 6 ins. in width, spaced 42 ins. between centers. The front rails are single, and are cast integral with the main sections. Forward of the cylinders, the frames are bolted to a combined deck plate and bumper casting which was furnished by the Commonwealth Steel Company, and is designed to house the Miner draft gear. This casting is a large and elaborate piece of work, cored out to omit superfluous weight wherever possible. Poling pockets are cast in the bumper at each end.

Running gear details include the Woodard leading truck, Cole design of trailing truck, and Cole long main driving-box. The wheels have a total lateral play in the boxes, of ¼ in.; and the first and fifth pairs of wheels have ¼ in. more play between the flanges and rails than the second and fourth pairs. The main wheels have plain tires. In spite of the long rigid wheel-base (22 ft. 0 in.) the locomotive can traverse curves of 16 degrees.

Where practicable, the details of this locomotive have been made to interchange with corresponding part of the latest Mikado type engines built for the Erie. Such parts include driving-boxes, axles, tires and shoes and wedges (excepting, in each case, those for the main wheels), pilot, frame cross-ties, brake shoes and heads, many brass fittings, and tender trucks complete. The equipment of the new engine includes flange oilers on the leading driving-wheels, and also a speed recorder which is operated from the rear truck.

The tender is of the Vanderbilt type, with capacity for 10,000 gallons of water and 16 tons of coal. The frame is composed of 6 ins. by 4 ins. angles, with front and back bumpers of cast steel.

The trucks have cast steel side frames, and the wheels are of solid rolled steel, manufactured by the Standard Steel Works Company.

The 2-10-2 type, although it has thus far been used to only a limited extent, has achieved remarkable success in heavy freight service. As there are undoubtedly many localities where this class of power could be employed to advantage, its increasing use in the future may be anticipated.

The following are the general dimensions of this type of locomotive:

Gauge, 4 ft. 8½ ins.; cylinders, 31 ins. by 32 ins.; valves, piston, 16 ins. diameter.

Boiler—Type, conical; diameter, 90 ins.; thickness of sheets, ⅞ in. 29-32 in., 15-16 in.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Firebox—Material, steel; length, 132¼ ins.; width, 96 ins.; depth, front, 89½ ins.; depth, back, 75½ ins.; thickness of sheets, sides, ⅜ ins.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ⅝ in.

Water Space—Front, 6 ins.; sides, 6 ins.; back, 6 ins.

Tubes—Material, steel; diameter, 5½ ins. and 2¼ ins.; thickness, 5½ ins., No. 9 W. G.; thickness, 2¼ ins., No. 11 W. G.; number, 5½ ins., 48; 2¼ ins., 269; length, 24 ft., 0 ins.

Heating Surface—Firebox, 258 sq. ft.; comb. chamber, 63 sq. ft.; tubes, 5443 sq. ft.; fire-brick tubes, 37 sq. ft.; total, 5801 sq. ft.; grate area, 88.1 sq. ft.

Driving Wheels—Diameter, outside, 63 ins.; diameter, center, 56 in.; journals, main, 13 ins. by 22 ins.; journals, others, 11 ins. by 13 ins.

Engine Truck Wheels—Diameter, front, 34 ins.; journals, 6 ins. by 12 ins.; diameter, back, 42 ins.; journals, 9 ins. by 14 ins.

Wheel Base—Driving, 22 ft., 0 ins.; rigid, 22 ft., 0 ins.; total engine, 41 ft., 3 ins.; total engine and tender, 77 ft., 4½ ins.

Weight—On driving wheels, 327,250 lbs.; on truck, front, 24,450 lbs.; on truck, back, 56,000 lbs.; total engine, 407,700 lbs.; total engine and tender, about 586,300 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 6 ins. by 11 ins.; tank capacity, 10,000 gals.; fuel capacity, 16 tons; service, freight.

Engine equipped with Schmidt superheater. Superheating surface, 1377 sq. ft.

Some Injector Lore.

It is a long time since the steam injector first came into use, but there are engineers still alive who witnessed the advent of this convenient boiler feeder and some of them remember that its action was regarded as a mystery and a violation of nature's laws. To force water against the steam pressure that was actuating the injector, seemed an anomaly, to say the least about it, but that anomaly was made plain to people who understood the laws of induced currents.

One of the best authorities living on matters pertaining to injectors and steam jet work is Strickland Kneass, who has made many tests of injectors that every engineman ought to be acquainted with. His tests demonstrated that a first class injector will feed into a boiler about 13 pounds of water for every pound of steam used. The solving of simple problems of steam engineering gives excellent exercise for people connected with the management or operation of steam engines.

To find the amount of steam used in the case mentioned, we divide the number of pounds, 2,228, by 13, and find that the work of feeding it requires 171 pounds of steam, and, of course, this much more water in the boiler to make it from. As every pound of steam used by the cylinders must be forced into the boiler in the form of water, we see that the injector takes at least one-thirteenth of all the steam made by the boiler, and some engineers place this as high as one-tenth, or 10 per cent. This will vary with the pressure of steam carried, as an injector will throw more water per pound of steam at low pressures than at high pressures. In fact, at high pressures, some tests have shown that less than 9 pounds could be counted on regularly per pound of steam used by the injector.

In this connection the question is often asked: How fast does the jet of water travel going into the boiler? Taking the same case, we have a good example to work out by assuming that one injector feeds the boiler so that we call it feeding 2,500 pounds per hour, as this is but little more than the sum of the two amounts we have found.

As there are 231 cubic inches to the gallon, and a gallon weighs 8 1-3 pounds, we divide 231 by the 8 1-3 or 8.33 and find that there are 27.73 cubic inches of water in a pound. So we multiply 2,500 by 27.73 and get 69,425 cubic inches.

Calling the area of the smallest opening in the discharge tube of the injector one-twentieth of an inch—and this will be nearly correct—we are a step nearer the answer, but it requires a little more figuring to get it. In going through the injector the water becomes a small stream or jet only one-twentieth of a square inch in size, so that if we imagine it stretched out in a long stream, it would be 20 times 69,425 inches long, because if it were one square inch in size it would be as long as the total number of cubic inches it contains.

Multiplying 69,425 by 20 gives us 1,388,500 inches long, or dividing by 12 to give it in feet, 115,708 feet long. The injector then feeds a stream of water 1-20 of one square inch in area by 115,708 feet long every hour, and assuming that it is running all the time, this would give one-sixtieth of this as the speed of the water in feet per minute, or 1,930 feet per minute. As a matter of fact, the injector will not be operating over one-half or one-third of the time, which would bring this up to 3,860 or 5,790 feet per minute, the latter being over a mile a minute. Various calculations made from actual injectors at work have shown that a mile a minute is not especially high for the jet of water to attain, and this is frequently exceeded. This shows how such calculations are made, and also how one can find out almost anything wanted that can be figured, if, after getting a few facts or dimensions to start with, we think out just what to do to make the desired answer come out of the figuring. It is simply good common sense applied to the fundamental rules of arithmetic in most cases.

Influence of the Brick Arch.

The use of the brick arch in locomotive fireboxes is making steady progress, but there are still many enginemen who fail to have clear ideas concerning the advantages of the arch. At last convention of the Traveling Engineers' Association, a report was submitted on "Prevention of Smoke," which raised an interesting discussion.

In one report the following expression occurs: "The brick arch is a great aid to smoke elimination, as it increases the travel of the gases and gives them a chance to combine with the oxygen." That statement raised some discussion, one side holding that the arch decreased the travel of the gases while the other held that it merely retarded them. Our experience with the brick arch indicates that it performs several functions that contribute to improved combustion and fuel economy. When a locomotive firebox has no brick arch, the fuel gases make a direct spring from the surface of the fire into the flues where the act of gas combining ceases. When the brick arch is used, the gases must pass from the surface of the fire over the arch making a much longer journey than when they pass directly into the flues, thus increasing the travel and retarding the flow. The effect of this is that the gases meet an obstruction which has a mixing effect, bringing about the chemical combination which generates all the heat the gases are capable of producing. Without receiving this mixing process the gases are liable to pass away in separate elements that produce a minimum quantity of heat.

When the mixture of the gases is incomplete, the act of combustion produces carbon monoxide, which has only about one-third the heat intensity of carbon dioxide, known as carbonic acid gas. When the supply of air is ample and the opportunity for mixing good, the gases formed are carbon dioxide, which always produce a free steaming engine.

Catechism of Railroad Operation

[illegible]

Third Year's Examination.

[illegible] 1915.)

Q. 170.—When should wedges be re- [illegible]

A. [illegible] moved up as far as it will go and the box still [illegible]

[illegible] will go when it strikes the top frame rail.

Q. 171.—When should wedges be set up?

A. [illegible] between wedge and shoe.

Q. 172. -What work about the engine [illegible]

A. Setting up the wedges, keying up [illegible] cessful trip and prevent engine failure.

Q. 173.—At what time or place should wedges be set up to obtain the best results?

A.—Either on arrival at terminal at completion of trip or at some place on road after engine has been pulling train and working hard; then the frame and other parts are expanded so that the wedges can be properly adjusted under the right conditions.

Q. 174.—How do you proceed to set up wedges?

A.—Get the engine on a piece of straight level track, place her on the top quarter on side you desire to set up first, cut out driver brake and apply tender and truck brake, or block tender and truck wheels; admit a little steam with reverse lever in forward corner—this will pull the box away from the wedge; go under the engine and set the wedge up as far as it will go; then pull it down one-eighth of an inch for dope packed boxes and one-quarter of an inch for hard grease packed boxes, to allow for expansion of box and prevent the wedge and box from sticking; set up the main wedge first, then the other [illegible] way.

Another way—Place the engine on the top back eighth on the side you desire to work on first, having engine on straight level track; put block on rail ahead of wheel on opposite side, with reverse lever in the forward corner; admit steam to pull box away from wedge, set up the [illegible] posite main wedge in same way, then [illegible] forward eighth on right side, then it will be on top back eighth on left side (if a right lead engine); set tender brake, place reverse lever in forward corner, [illegible] sides away from wedges; go under engine, set up main wedges first, then the others, as explained above,

A good way where solid rods are newly fitted with bushings—Place block on rail back of driver so that when wheel hits it the rods will be on dead center, start engine moving back and let her drift onto the block; this will throw the box away from wedge; so wedge can be set up to the box, and it prevents getting rods and boxes out of tram; handle each wheel in same manner, setting up main wedges first.

Another way—Place engine on dead center on side you are to work at wedges, use pinch bar to throw wheels ahead, then set up wedges.

Note.—The last explanation is for the [illegible] dead engines and new work, but it is always best to have the engine hot and parts expanded when wedges are to be [illegible]

Note.—Where engines have keyed side rods it is a good method to slack back the keys before setting up the wedges.

Q. 175.—What would you do if wedge bolt broke and the wedge came down on top of binder?

A.—Sometimes the broken wedge bolt can be spliced with a nut and then the wedge can be adjusted with the bolt. If this is impossible, raise the wedge to proper height and secure it there by block- [illegible] the jaws.

Q. 176.—How would you handle a stuck wedge to get it down?

A.—Strain down on wedge with wedge bolt, then run the wheel over a nut or coal pick placed on rail; this will generally bring them down, but if it does not, slack off on the binder bolts and run over the block on rail again; this failing, loosen up more on the binder and run the wheels ahead and back of the one with stuck wedge up on wedges, having both up at the same time; this will open the jaws of the box and the wedge will come down; tighten the binder and adjust the wedge so it will not stick again.

Note.—Sometimes a little signal oil or kerosene oil poured in between jaw and wedge and box and wedge will help to [illegible]

Q. 177.—How do you locate a stuck [illegible] a wedge was seized or stuck?

A.—The engine would ride hard and every rail joint would cause a heavy jar, [illegible] wedge is stuck.

To locate the stuck wedge would go out on running board and note the movement of boxes in jaws; if a box was not moving up and down in the jaws when the engine was in motion, the wedge at that box is stuck.

Q. 178.—Why are side rods provided with knuckle joints?

A.—To allow for the free movement of the wheels over uneven track without bending or breaking the side rods.

Q. 179.—How would you proceed to key the side rods on a Mogul or a Consolidation engine?

A.—Have the wedges properly set up; place engine on dead center on side you are to key first, having engine on piece of straight level track; on engines having but a single key at intermediate and front and back connections, drive the key at intermediate connection on side next main pin, first keying brasses so they are close to pin and still move freely on pin; then key the brasses at main connection, driving key in solid portion of rod first so as to get that part of the rod of proper length between main and intermediate pins; then drive the other pin at main connection to close brasses to fit pin closely, but move freely on pin; then key the forward and back brasses, move engine to the other dead center, and try all brasses to be sure that they move freely at that point also.

Note.—When keying brasses on side rods, keys should be driven so rods will be as long as possible between pins and still move freely at all points of the revolution, and if there is any slack in the rods, it should be lengthways so there will be no strain on the rods when the wheels are moving up and down over the uneven track; this will make the knuckle joints and brasses wear longer without renewal.

Note.—Where there are two keys at the intermediate connection, the main connection may be keyed first, then drive the key nearest the main pin at the intermediate connection to get the solid portion of rod the proper length, using key on other side of pin to close brasses to fit pin, and if two keys are used at each of the forward and back ends of the rod, always drive the key on side towards main pin first so that the rods will be proper length between pins; then after you have the brasses all keyed, be sure to place the engine on the other center to make sure that brasses are free at that point, because a pin sprung or drivers out of tram might cause the rods to bind and run hot.

Q. 180.—Why place the engine on the [illegible] center on [illegible] level, when keying side rods?

A.—To prevent keying the side rods too long or too short, or out of tram.

Q. 181.—If side rods are keyed too long or too short, where will they bind?

A.—Passing the dead centers, because that is the rigid point, and all the relative

wheel and pin centers must be equally distant from each other and are held rigidly in that position passing the dead centers.

Note.—The dead wedges or shoes are placed in the driving box jaws in front of the driving boxes, to determine the proper location for the wheel centers, and maintain the wheel centers in their correct relative positions (in tram) when the live wedges are properly adjusted.

Q. 182.—What is meant by "Engine out of tram"?

A.—When the distance between wheel centers on one side of engine is greater or less than the distance between the corresponding wheel centers on the other side.

Q. 183.—What is meant by "Rods out of tram"?

A.—When the rods are keyed or fitted up so that the distance between pin centers is greater or less than the distance between the corresponding wheel centers.

Q. 184.—When should rod brasses be reported to be closed or refitted?

A.—When they are keyed solidly brass to brass and pounding on pin.

Q. 185.—When should rod brasses be reported to be lined?

A.—When the key is driven as far as possible and the brasses are working in the strap.

Questions Answered

BRITISH THERMAL UNIT.

G. D., Macon, Ga., asks: What is the meaning of the term British thermal unit, and how is it applied in combustion? A.—The British thermal unit, generally expressed in the letters B. t. u., is the quantity of heat required to raise the temperature of one pound of water one degree. As a gallon of water weighs 8⅓ pounds, it requires 8⅓ B. t. u. to raise the temperature of one gallon one degree, or 16⅔ B. t. u. to raise the temperature two degrees, and so on. Thus, when a given coal is said to have a heat value of 13,800 B. t. u. per lb., it is meant that if all the heat caused by the complete combustion of one pound of that coal could be transmitted to 13,800 pounds of water it would raise the temperature of that water one degree. Or, if all the heat could be transmitted to, say, 138 pounds of water, it would raise the temperature of that water just 100 degrees, because 138 x 100 = 13,800. The pounds of water heated multiplied by the number of degrees the temperature has been raised equals the number of B. t. u. The standard method of finding the heat value of a fuel is to burn a small sample of it in a tight steel bomb under water. The heat caused by the burning of the sample is then all absorbed by the water and by multiplying the weight of the water by its rise in temperature and dividing by the weight of the sample, the heat value of the coal is calculated direct in B. t. u. per pound.

ELEVATION OF RAILS AND DEGREES OF CURVES.

"X.," Alamosa, Colo., asks: What is the proper elevation for curves of from ten to twenty degrees for speed of thirty-five miles per hour? And give rule of determining this, and also the simplest rule for determining degree of curve. A.—The amount by which the outer rail should be elevated on a curve may be determined from the following formula adopted by the American Railway Engineering and Maintenance of Way Association:

$$E = .00066\ DV^2,$$

Where
- E = elevation of outer rail in inches,
- D = degree of curve,
- V = velocity of train in miles per hour.

Hence $.00066 \times 10 \times 1225 = 8.085$ inches.

Ordinarily an elevation of eight inches is not exceeded, and speed of trains should be regulated to conform to that elevation. In regard to degrees of curves, a simple rule which gives results close enough for practical purposes is to take the middle ordinate of a 62-foot chord; the length of the middle ordinate in inches equals approximately the degree of curvature. In other words stretch a line 62 feet in length touching the outer edge of the inner rail. Measure at the center of the line the distance from the rail to the line, and the number of inches will correspond to the number of degrees of the curve.

[illegible]

J. W. K., Seattle, Wash., asks: How much does water expand under increasing degrees of heat and increasing pressure in the boiler? A.—There is no formula by which you can at once find the increase in the volume of heated water at varying temperatures, as the expansion is not regular like that of mercury in a thermometer. A volume of water at a temperature of 39.1 degrees Fahrenheit is placed by eminent authorities as that of unity, as water at this temperature attains its greatest degree of density. At 50 degrees the volume increases to 1.00025; at 104 degrees it would be 1.00767; at 149 degrees it would be 1.01951, and at 212 degrees, or boiling point, it expands to 1.04332.

[illegible]

D. H., Souris, Man., Canada, asks: If water was forced through a pipe at 180-pound pressure, would it have sufficient momentum to enter the boiler where the steam was at a pressure of 180 pounds? A.—If the supply of water came from a higher level than the water in the boiler, the water would find its way into the boiler irrespective of any pressure upon the water, but as soon as the level was equalized it would require a superior pressure to force more water into the boiler. The invention of the injector overcame this physical condition by reason of the advantage created by the vacuum induced by the steam coming in contact with the colder body of water, and the vacuum so produced causes the mixture of steam and water to pass through the injector and overcome the boiler pressure by reason of the increased impact gained by the vacuum.

High Speed Drill Press

The College of Engineering of the University of Illinois has recently installed a high production drill press in its machine shop. This press is to be used in a series of tests on drilling in metals. The machine is of heavy construction, weighing 2,600 pounds, and has sufficient power to drive drills of high-speed steel to their ultimate capacity.

At the highest rate of production the machine forces drills through cast iron at the rate of 53 inches per minute. This is from three to five times the rate for ordinary drill presses, and almost equal to the rate of drilling wood a few years ago. The machine is of the all-geared type, no belts being used for power drive for any part of the machine. This geared drive eliminates the chance of slippage between motor and drill. All gears run in a bath of oil, and the machine is equipped with a circulating oil pump. This machine is equipped with a 7½ horsepower motor.

A double wheel drill grinding machine has also been added to the equipment in the machine shop. This grinder has a wide range of adjustments, and makes possible the systematizing of drill grinding. With this grinder it will be possible to carry still further the noteworthy work of the Illinois shops in devising and using special tool sharpening appliances.

The Railroad Industry.

In the railroad industry there are 1,848,883 employees to whom it pays $1,390,025,286 in wages.

Forty four cents of every dollar spent by the railroads is paid to labor.

9,244,015 persons dependent upon it for a living, if families of employees be counted

1,000,000 workers in plants furnishing railroad material and supplies; 5,000,000 counting their families. About 25 cents of each dollar received are paid out for materials and supplies, the bulk of which goes into the pay envelopes of those who produce them.

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Fair Railroad Rates.

[illegible] Supreme Court has clarified the railroad rate question by holding that all passenger and freight rates must be fair. The West Virginia passenger rate case and the North Dakota coal rate case in conjunction with previous decisions upholding the [illegible] Commission to fix reasonable rates and to prevent discrimination against one set of shippers or localities in favor of others, [illegible] rates as interpreted by the highest court [illegible] something approaching to justice in the future.

It is distinctly understood by the decision that hereafter railroads must not charge excessive rates or practice discrimination, and on the other hand that Congress, State legislatures, the Interstate Commerce Commission and all State railroad commissions must permit railroads to charge rates that are compensatory, that is, the rates must be such that pay a fair profit after all legitimate expenses are paid.

Railroads can come into being and do business only by receiving from the sovereign people certain extraordinary privileges, such as the right of eminent domain without which no right of way through settled country could be obtained at a fair price. In return for these privileges they must treat the public fairly and they must submit to reasonable regulation by legislative bodies and commissions. In return for extraordinary favors, not granted to ordinary persons or corporations, they must serve the public efficiently and they must sell transportation at the lowest rates which can be made to yield a fair profit on the investment. These broad principles are now clearly defined and firmly established by a series of Supreme Court judgments which seem to cover all contingencies. Shippers, passengers and railroads now have a fair field and no favor.

These comments naturally give rise to the thought that it seems strange that under the American Constitution, by far the noblest instrument ever devised by man for the government of man, it should be weak and vacillating in its application on the simple matter of fair dealing, and leads to the conclusion that the American people in the aggregate are not yet quite fitted for the full realization of the admirable constitution under which they live. The causes are not far to look for. Especially in the larger municipalities a set of men get into office by questionable methods. Many appointments are made more with a view of doing the most good to deserving partisans than for the welfare of the community. While the Civil Service regulations have made many marked improvements in the public service, its application to special commissions does not seem to have been thought of. The past records of many of the appointees to the most important commissions seem to have no bearing whatever on the duties devolving on the commissioner. The world moves slowly, and the [illegible] average politician is a hindrance to human advancement. [illegible] the ship of state, a clinker on the firebox of civilization, a flat spot on the wheels of progress. He should not be amended, he shoudl be abolished.

Relation of Grate Area to Combustion.

At the last convention of the Traveling [illegible] a discussion, Mr. W. C. Hayes remarked: "There is one point that has recently developed in tests made on the Erie Railroad with which I do not agree. I do not believe that any engine, no matter what its size may be, should have less than 100 per cent. of the square of the area of the flue openings through the ash pan, and if it gets 150 per cent. I should be much more pleased." Mr. Kinyon said that by changing engines from 40 to 90 per cent. grate opening he had effected a fuel saving of 22 per cent.

This subject of grate opening has been a favorite theme with us for years, and the following article was written in our desire to eliminate certain vicious practices of locomotive designing:

We have for several months past been investigating the subject of locomotive grates, and watching in all quarters within our reach the practices followed in the designing of grates. The practice of grate designing on some roads reminds us of the action attributed to a verdant son of the Emerald Isle, who, finding his bed clothes too short, cut a strip off the top and sewed it upon the bottom, so that it might cover his feet. The erratic designers have their locomotives proportioned so that they may have a liberal grate area, and at times they are so anxious to obtain this that they spread the driving wheels an inconvenient distance apart, and then having by this means obtained the large area inside the foundation ring, they exercise ingenuity to fill the greater part of the space with solid iron. When grate area is mentioned, it is generally understood that about two-thirds of the space will be covered with iron, and one-third left open to admit air; yet we find that the open area in the grate is reduced to one-fourth in many cases, and that one-fifth is not uncommon. This, too, with engines that are called on frequently to burn the fuel very rapidly to generate steam for heavy service. On certain roads the mechanical authorities are doing all in their power to get large grate area and liberal proportion of opening; on other roads they are making large grates and then stopping most of the openings with solid iron, while on a third class of our railroads, the tendency is to keep to small fire-boxes and restricted grate area. Wide diversity of practice may be necessary or admissible, owing to difference in the quality of fuel used; but some one must be wrong when we find the difference stated in districts where the same quality of coal is used and the condition of locomotive service about equal.

We do not believe that grate surface which leaves much more air opening than the sum of the cross section of the flues is economical, except in cases where specially fine coal is used that tends, by the compact way in which it lies on the grates, to neutralize the effects of liberal opening space, or where the locomotive is worked very hard the greater part of the

time. But there is good reason for believing that the economy which will naturally result from increasing the grate area within admissible limits is sometimes lost through mis-management due to ignorance of the laws relative to combustion of fuel.

Grates are so constructed that they will carry the fuel and supply through their openings the air needed to effect combustion. If the air is restricted so that the gases do not receive their natural supply, there will be loss of heat; if, on the other hand, the air passes through the grates in such a way that part of it passes into the flues without mixing with the fuel gases, it will absorb and carry away part of the heat generated. To make the supply of air harmonize with the quantity of fuel burned, the force of the draft employed to induce the current of air should have some relation to the grate openings. As the draft of the locomotive is regulated principally by the exhaust nozzle, it might be supposed that its area of opening would be regulated to suit the extent of grate surface; yet the natural connection between these parts is seldom recognized. As a rule, the exhaust nozzle is proportioned to the size of cylinder and its relation to the grate area neglected, although the natural connection between nozzle and grate are more intricate and potent than the relation between cylinder and nozzle.

The exhaust steam has to perform a considerable amount of mechanical work against the atmosphere to maintain the proper velocity of air influx. If the area of air admission were reduced the velocity of the inflowing air would have to be accelerated to maintain the necessary supply, and if the grate area or openings were increased, the exhaust nozzle remaining the same would draw too much air for the coal to be burned. In practice the exhaust is regulated to draw in the air needed for a large coal consumption on a small grate, and the same proportion is retained in cases where the grates are made larger, with the result that locomotives having large grates are seldom so economical in fuel as they ought to be, because a large proportion of the heat is lost through the fire-box being habitually flooded with superfluous air. In numerous cases putting in grates with a reduced percentage of opening has reduced the fuel consumption, when the proper remedy should have been enlarging the exhaust nozzle, to harmonize with the grate area. When a master mechanic is told by his foreman that the steaming of an engine has been improved by the reduction of the grate area, he may safely conclude that an increase of brain labor is called for to make the engine work properly. If, however, a grate is so long that an ordinary fireman cannot keep it covered evenly, there may be economy in closing part of the front with dead plates. When a large quantity of fuel has to be burned on a given grate area, the heat of the furnace is higher than when a smaller quantity is burned, and the intensity of temperature will at times prevent loss of heat; but a terrific rush of air and gases towards the flue openings, the ordinary feature of highly forced combustion, is apt to carry away unconsumed fuel leading to unnecessary throwing of sparks.

Merit of Advertising

We live in a country town of 25,000 inhabitants, where we are constantly hearing complaints that business is dull and that the people are too much given to purchasing goods in large cities, that could be bought cheaper or at no higher price in the home stores. This is no doubt true, but the real trouble is that the home storekeepers do not let the people know what they have got to sell. They fail to advertise, and their rivals in the large cities take the business because they make liberal use of printers' ink. The home town storekeepers sleep too much, and imagine that their business will keep active while they are inactive and their rivals are hustling.

Standing advertisements in a paper command confidence. The man who for a year lives in one community and leads a reputable life, even though he be of moderate ability, will grow in the confidence and esteem of his fellows. On the same principle, a newspaper advertisement becomes familiar in the eyes of the reader. It may seldom be read, still it makes the business of the man or the company familiar to the reader, as its presence in the newspaper column inspires confidence.

When business becomes slack some men at once exclaim we must stop advertising. That is the very worst policy. True business principles demand increase of advertising and the men who have the sense to realize are the men who pass through hard times with the smallest loss of business.

The Full Crew Law.

Governor Fielder has shown much good sense in contending that the question of the proper manning of trains should be definitely conferred upon the Public Utilities Commission. The railroads generally reiterate this opinion, and surely it seems more reasonable than to put such questions to the opinion of the voters at an election, because the general public have by long experience been accustomed to party guidance, and it is impossible that a thorough knowledge of the requirements of railroad service could be learned by the body politic to such a degree of capability as to be able to render a just judgment. If such a method as referring the question of the exact number of employees to be used in certain service should ever reach its logical conclusion then there would be no kind of occupation into which this might not run. The organic foundation of the American constitution provides for a delegated government, and nowhere is it more necessary than that the wisest and the best amongst us should be chosen to regulate such questions that may arise in the industrial life of the people.

Out of the discussion it is to be hoped that good may come—a lasting good that will place the question beyond the intermittent spasms of needless meddling that only ends in making confusion worse confounded.

Distinction Between Energy and Power.

Engineering writers are much in the habit of using the terms energy and power as if the words were synonomous, but there is a distinct difference in the two terms when they are properly analyzed. In many ways the conception of energy has been rendered popular, but a clear idea of the relation of energy and power is difficult. This arises from the extreme generality of the terms; in any particular case the distinction is easy. It is easiest to express this distinction by an analogy; but as a matter of fact everything that seems analogous is really an instance of energy. Power may be considered to be directed energy, and we may liken many forms of energy to an excited mob, while the directed forms are likened to a disciplined army.

Energy in the form of heat is in the mob form, while energy in the form of a bent spring, or a raised weight, water moving in one direction, or of electricity, is in the army form. In the one case we can bring the whole effect to bear in any direction, while in the other case we can only bring a certain portion to bear, depending on its concentration. Out of energy in the mob form we may extract a certain portion depending on its intensity and surrounding circumstances, and it is only this portion which is available for mechanical operations.

Now energy in what we may call its natural sources has both these forms. All heat is in the mob form, hence all the energy of chemical separation, which can only be developed by combustion, is in the mob form, and this includes the energy stored in the medium of coal. The combustion of one pound of coal yields from ten to twelve million foot pounds of energy in the mob form of heat; under no circumstances existing at present can all this be directed, nor have we a right, as is often done, to call this the power of coal. What the exact

[illegible] this, that is [illegible] million foot [illegible] coal is the extreme limit it can yield under the present conditions of temperature at the earth's surface. But before this energy becomes power it must be directed. This condition is at present performed by the steam engine, which is the best instrument art has yet devised, but the efficiency of which is limited by the fact that before the very intense mob energy of the fire is at all directed, it has to be allowed to pass into the less intense mob energy of hot water or steam. The relative intensity of these energies are sometimes like twenty-five to nine. The very first operation of the steam engine is to diminish the directable portion of the energy of the pound of coal from nine millions to three millions. In addition to this there are necessary wastes of directable energy, and a considerable expenditure of already directed energy in the necessary mechanical operations. The result is that, as the limit, in the very highest class engines the pound of coal yields about one and a half million of foot-pounds; in what are called "first class engines," such as the compound engines on steamboats, the pound of coal yields one million, and in the majority of engines, about five or six hundred thousand foot-pounds. These quantities have been largely increased during the last few years; as far as science can predict they are open to a further increase. In the steam engine art is limited to its three million foot-pounds per pound of coal, but gas engines have already made a new departure, and there seems no reason why art [illegible] the nine millions."

Abuse of the Throttle Valve.

At the third annual convention of the Traveling Engineers' Association, held in 1895, twenty years ago, one of the subjects reported upon and exhaustively discussed was: "What effect has the proper or improper manipulation of the throttle, cut-off and boiler feed on the coal consumption?" Up to that time there was seldom any question raised concerning the desirability or otherwise throttling the steam as it passes from the boiler to the cylinders, and a sentiment had become [illegible] neers that it was necessary to throttle the steam in order to lighten the pressure upon the slide valves. But when the question came before a body of intelli[illegible] gospel of steam engineering which ex[illegible]pansively, a new light was shed upon the [illegible] much pressure upon the slide valves has robbed many locomotives of a great share of their natural efficiency. Still the subject needs continued ventilation.

One of the subjects to be reported upon and discussed at the next Traveling Engineers' Convention is: "Effect of properly designed valve gear on locomotive, fuel economy and operating." That is a good subject, but our sympathies move strongly towards urging that existing valve gear be given the opportunity over fuel economy that it possesses.

The tendency of American railway mechanical engineers and locomotive designers has been for years towards higher boiler pressure, the reason given for the movement being that high boiler pressure permits of a more effective cylinder pressure, with consequent greater workout of a given volume of steam. Theory in this is probably sound, but the practice of locomotive operation has rendered an excellent theory and sound principles fruitless of good work. Sensible people ask, what is the use of carrying 200 pounds or higher pressure in a boiler, if it is to be habitually reduced 50 per cent. or more before reaching the cylinders. Complaints are constantly reiterated that the brisk motion and plain slide valve render the efforts of high steam advocates futile, since they do not admit and release the steam so promptly as these operations are performed in automatic engines. But what is the use in trying to design an improved valve gear for locomotives when that in use is seldom permitted to do its best [illegible] vitality by the throttle valve. The engi[illegible] existing engine is likely to be productive [illegible] designs intended to save steam. Recent improvements that have produced a more durable and convenient valve motion than the link are moves in the right direction, but attempts at changes which will promote expansive working of steam will continue to be lost labor, so long as the man regulating the throttle valve con[illegible] source is the proper method of handling an engine.

Two leading reforms are necessary with the locomotive in use before radical improvements are called for. Means should be taken to see that the fuel is burned in the manner that will impart the greatest possible amount of heat to steam generation; and when the steam has been formed it should be permitted to push the pistons with the highest possible pressure. Many railway companies are working hard to popularize sound methods of firing and great reforms have been effected in that line of enterprise, [illegible] pernicious practice of running with a partly closed throttle.

Steel Pipes.

It may not be generally known that steel pipes have nearly superseded iron pipes, more particularly in ground where corrosive influences are strongest. A safe and certain method of prevention is the dipping of the pipes in a solution before leaving the manufactory. This method has been very successfully introduced by the National Tube Company, Pittsburgh, Pa. The methods adopted by the enterprising company are an absolute safeguard, and experience has demonstrated that it is to be relied upon in all climates. Some pipe lines for water run to great lengths. One line in Australia is 360 miles in length, and traverses every description of country. One great advantage in the use of steel pipes is the cheapening of carriage, as steel is less than half the thickness of iron, and consequently the difference in weight represents a great economy on large contracts.

Judging Train Speed.

A technical paper answering a question asked about how an engineer judged the speed of trains said: "He gauges speed by the motion of the crosshead or other movable part." From long experience gained in the locomotive cab, we are disposed to think that the person who gave that answer had no experience in judging the speed of a locomotive. As on most locomotives, the motion of the cross-head cannot be watched from the cab unless a person leans out of the window, [illegible] judging speed, especially on a dark night, or when the thermometer mercury has lost its way down in the bulb. An engineer who had to watch the motion of the cross-head on such a night in order to tell how close he could make a meeting point, would be apt to lose an ear during the process.

Every efficient engineer can tell pretty accurately how fast an engine is [illegible] stances that would be terribly confusing to a novice; but very few engineers can tell how they understand about the speed. Judging accurately the speed of a train is, like all operations, based on skill reached only by practice, and the men most expert at the work can seldom explain clearly how it is done.

In a court of justice dealing with a train accident, the magistrate asked the engineer, "Will you take your oath that you were running 55 miles an hour?"

"Yes," was the reply, "I swear that I was running 55 miles an hour."

Magistrate: "Will you swear how you

know that you were running 55 miles an hour?"

Engineer: "I swear that I was running 55 miles an hour, but I also swear that I don't know why I know that I was running at that speed."

In daylight the trained man can readily tell whether or not he is keeping time, by the movement past telegraph poles and other stationary objects; but when dense darkness makes all objects invisible, other means of judging speed must be found. Express trains keep time as well in the night as they do in daylight, so it must be concluded that the engineers in charge know how to regulate the speed. They do so by a sort of instinctive process, various small things that to the untrained ear or eye would be meaningless supplying the means of judging speed. Objects are seen differently in a clear night from what they are in a dark night, and high wind or heavy rain introduce their own confusing elements; while a rough piece of track would make a raw runner imagine he was running at terrific speed when he was losing time. The instinctive power of training raises the experienced engineer above the influence of deceptive surroundings, and in the worst night that blows, the click of the wheels on the rail joints, the rumble of the wheels upon the rails, or the flash of light upon a passing object, enables the expert to tell how he is getting along, but the cross-head is seldom seen between stations.

Pernicious Whistling.

We have recently noticed complaint made by the authorities of several cities of the annoyance caused by unnecessary use of the locomotive whistle. The pernicious use of the steam whistle for steamboats and factories equipped with the noise creating whistle are in many cases worse violators of the public peace than locomotive engineers. The amount of useless whistling done by the steamers on the Hudson River within sound of the New York or New Jersey communities is an outrage upon the peace loving people.

The idiotic laws of many states are to blame for excess of locomotive whistling that is annoying the whole country. The statutes of many states require the locomotive whistle to be sounded at a great many places, and the men in charge fall into the habit of thinking that the oftener the whistle is blown, the more conscientiously they are doing their duty. In early railway days, when the control of a train was not directly in the hands of the engineer, frequent use of the whistle was a necessity; but the inventions that have given the engineer power to stop the train at will have changed all this, yet the amount of whistling is not [illegible].

It is doubtful if today the locomotive whistle is not the direct cause of more serious accidents to life, limb and property, than what are balanced by saving from its use, and it is certainly the cause of much suffering and discomfort to invalids and nervous persons. A great portion of the unnecessary screaming of steam whistles is caused by want of reflection concerning the suffering caused. We say, Mr. Engineer, blow softly and with mercy to others.

Matter and Atoms.

People who studied chemistry years ago were informed that matter consisted of certain elementary substances formed from minute particles called atoms, which were indivisible, a theory that comes down from remote antiquity. Until exceedingly careful experimental work was carried out by modern chemists, early in last century, the atomic theory was merely speculative opinion.

Modern methods of research and the extraordinarily accurate instruments employed by physicists have, however, ended all speculation concerning the existence of atoms, but they have also demonstrated that the atom is not the ultimate entity of matter but is divisible into smaller parts than the ordinary atom. The smaller entities are known as electrons, and it is not difficult to obtain some conception of the number and distribution and motion of these electrons within the atom. Furthermore, radio-active elements, such as radium or thorium, consist of atoms in a state of disintegration or dissolution, and it has been possible to detect single electrons protected from radio-active matter, and also to ascertain that a radium atom may eject the large nucleus of the smaller helium atom.

We dilate on this subject of the atom because many of our readers in studying heat and combustion are made familiar with the atomic theory of matter.

An Efficient Shop Foreman.

Some years ago a very successful superintendent of railway motive power, having been asked to describe the qualifications likely to produce a first class shop foreman, wrote as follows:

"The selection should be made from the shop force, and from the class that are active, energetic, conservative and progressive, with moral character predominating, giving preference to the oldest men if merits are equal. In qualifications, some knowledge of figures, reading and writing are essential; being able to read drawings, to comprehend orders clearly and quickly, mechanical skill, executive ability, systematic and thoroughness of work, and a full knowledge of what shall be done, as well as how it should be done are also desirable. Too much value cannot be placed on ability to impart knowedge to others, and it should be constantly the aim of the foreman to explain clearly and directly. Many fail in this particular and attempt to perform themselves what should be done by others. The old saying, 'As with the captain so with the sailors,' is especially applicable to shop foremen and any foreman can quite accurately be judged by the performance of the men."

We have known intimately many shop foremen and have been in the habit of studying their merits and methods, but we never met one who fulfilled all these requirements.

To Cheapen Gasoline.

If reports prove correct, Dr. Walter F. Rittman, of Sandusky, O., has discovered a refining method which will increase the production of gasoline from petroleum 200 per cent. Franklin K. Lane, Secretary of the Interior, referring to Dr. Ritt-[illegible]

The Federal Government, through the efforts of Dr. Rittman, now proposes to make free for the use of all the people of this country who wish it a process that is confidently expected to increase their yields of gasoline fully 200 per cent., and perhaps more, such results having repeatedly been obtained in the laboratory. It is claimed by Dr. Rittman that his process is safer, simpler and more economical than processes now in use, and these are economical factors of great importance.

Health and Safety First.

Safety First, which is becoming so popular a pass word among leaders of industry, has been taken up by the Franklin Institute and the importance of care in preventing accidents was urged at last [illegible]

The campaign of education in accident prevention among the general public as well as among workmen was fully set forth and its importance upon the welfare of the community at large was pointed out. Attention was called to the necessity for guarding against accidents in the home, the workshop, and in public places, and the numerous devices now in use for the protection of workmen and others were described. The sanitation of factories with special relation to prevention of diseases was also given full consideration.

Reports show that the American railroads paid in taxes in one year $129,191,880, equivalent to $1.43 for every inhabitant of the United States. The railroads are the country's largest tax payers.

Air Brake Department

Brake Improvements—Empty and Load Freight Brake

Brake Experiments on the Pennsylvania

Brake Improvements.

We know of several instances in which prominent railroad motive power men have been prompted to instigate a scientific investigation to determine the reason for the introduction of improved types of air brakes, and immediately thereafter became interested to such an extent as to make an extensive study of the air brake conditions that necessitate improvements in brake apparatus. Incidentally, many motive power men have come to recognize that outside of the earning capacity of the locomotive, which is largely made possible by the use of efficient brakes, there is probably no single feature in railroad operation that can earn more money, investment considered, than a well designed, correctly installed properly maintained and intelligently manipulated air brake system, and conversely, there can scarcely be any greater loss in revenue than by attempting to control trains under modern operating conditions with an inferior, indifferently maintained brake of incorrect design the accurate manipulation of which is practically impossible.

At the present day no air brake man will question the advantage of the use of the improved locomotive brake equipments known as the E. T. and L. T. and yet for high speed passenger service they leave something to be desired, the fact of the matter is that while almost perfect pneumatically, they are not quick acting enough to entirely satisfy the demands of high speed service.

[illegible] passenger car brakes has been dwelt upon at [illegible] but the actual [illegible] was inclined to be surrounded by an air of mystery until the air brake art, or science rather, had advanced far enough to consider the foot pounds of energy to be dissipated in a certain number of seconds time to produce an air brake stop in a given distance, and an analysis of the means [illegible] the energy, thereafter the need for improved passenger car brakes became obvious. Stopping trains in specified distances from high rates of speed constitutes an engineering problem of no small dimensions, and a money earn- [illegible] eration, but they go hand in hand as the large capacity brakes for high speed [illegible]

engineers never lose sight of the earning capacity in brake design. In order to illustrate in which way earning capacity may be considered, in one instance the engineers in summing up a certain condition which had been the subject of an investigation, decided that an improved brake on the cars in question would make possible a higher average speed, shorter schedules, for the same number of cars an increased traffic capacity and for the same traffic capacity fewer cars could be used and if it is only desired to secure economy in power consumption it can be done by an improved brake and the same average speeds, schedules and capacity can be retained. The idea is that if the time consumed in making a stop can be reduced from say 40 seconds to 20 seconds, it is possible to run with the power on for 20 seconds longer where with the old brake the train was run with the brakes on during 20 seconds. In this manner, due to a greater air brake efficiency, a saving of 10 seconds in running time between stops can be made; then in suburban service a two-hour trip of 100 stops of 40 seconds to the stop, a brake that will reduce the stop to 20 seconds will reduce the time of the trip to 1.44 hours, and while the train with old equipment is making one trip, the train with the new brake would make 1.39 trips. If each of these trains consisted of 5 cars the new brake would give the train a value of 62 cars per day as against 45 cars for the train with the old type of brake, and with say 60 passengers per car, the cars with the improved brakes would be capable of transporting 3,720 passengers as against 2,700 per day. From this it will be seen that an efficient [illegible] of numerous additional cars, as in congested districts inferior brakes would not permit of an increase in the number of cars operated because they would not permit of the necessary time between trains.

The [illegible] will illustrate the saving that may be made in power consumption by a brake that will manifest the improvement assumed.

In [illegible] train movement consists essentially of a period of acceleration and a period of deceleration, time between stops being [illegible] *improved brake equipment, it is possible to introduce a period of coasting.* A period of coasting implies a lower maximum speed which permits of a shorter accelerating period or allows steam (current) to be cut off sooner. It is evident that a *reduced steam (current) consumption* gives a *reduced coal consumption.* The following calculations indicate what the reduction might be.

CONDITIONS.

Average distance between stops, 1.3 miles.

Average speed between stops, 24 M. P. H.

Average time stop with old equipment, 50 seconds.

Average time stop with improved equipment, 25 seconds.

Weight engine and tender, 136,000 lbs.

Number cars in train, 8.

Weight per car, 80,000 lbs.

Train resistance during acceleration, 10 lbs. per ton.

3.5 lbs. coal per I. H. P. hour.

Efficiency from cylinders to crank pins, 85%.

Number accelerating periods per run, 12.

Actual length run, 17 miles.

Total runs per day, 75.

Cost of coal, $2.50 per ton.

Trains operated 18 hours a day.

COAL USED WITH OLD EQUIPMENT

1.3 miles ÷ 24 M. P. H. = 195 seconds between stops.

195 − 50 = 145 seconds time train accelerates.

$$\frac{\text{Max. Vel.}}{2} \times 145 + \frac{\text{Max. Vel.}}{2} \times 50 = 1.3 \times 5{,}280.$$

Maximum Velocity = 70.5 ft. per sec. = 48.0 m. p. h.

Maximum Velocity is attained in 145 seconds.

Acceleration = 48.0 ÷ 145 = .33 m. p. h. per second.

Weight train = 136,000 + (8 × 80,000) = 776,000 lbs.

$$\text{Accelerating force} = \frac{776{,}000}{32.2} \times \frac{.33 \times 5{,}280}{3{,}600} = 11{,}700 \text{ lbs.}$$

Force necessary to overcome train resistance, accelerate moving parts,

$$\text{etc.} = \frac{766{,}000}{2{,}000} \times 10 = 3{,}830 \text{ lbs.}$$

Total force to move train at rate indicated = 11,700 + 3,830 = 15,530 lbs.

H. P. at average speed of 24 M. P. H. =

$$\frac{15{,}530 \times 24 \times 1.47}{550} = 1{,}000 \text{ H. P.}$$

I. H. P. at 85% efficiency = 1,000 ÷ .85 = 1,180 I. H. P.

Coal consumption = 1,180 × 3.5 = 4,120 lbs. per I. H. P. hr.

Coal consumption per acceleration = 4,120 × 145 / 3,600 = 166 lbs.

Coal consumption per run = 166 × 12 = 1,999 lbs.

Coal consumption per year = 1999 × 75 × 313 ÷ 2,000 = 23,400 tons.

COAL USED WITH IMPROVED EQUIPMENT.

195 seconds between stops as with old equipment.

195-25 = 170 seconds time of combined acceleration and coasting.

Maximum velocity = M. P. H. per second times time of acceleration.

Assume M. P. H. per second, same as with old equipment = .33 M. P. H. per second.

Max. Velocity × time of acceleration + av. vel. coasting.

2 × time of coasting ÷ av. vel. deceleration.

[illegible]

1.3 × 5,280.

From above, time of acceleration = 126 seconds.

Coal consumption per acceleration = 4,120 × 126 / 3,600 = 144 lbs.

Coal consumption per run = 144 × 12 = 1,730 lbs.

Coal consumption per year = 1,730 × 75 × 313 ÷ 2,000 = 20,300 tons.

SAVING IN COAL.

Tons per year old equipment	23,400
Tons per year improved equipment	20,300
Saving	3,100 tons

3,100 tons at $2.50 per ton = $7,750.

RETURN ON INVESTMENT.

18 hours ÷ 75 trains = .24 hours between trains average.

17 miles ÷ 24 M. P. H. = .708 hrs. per trip one way.

.708 × 2 ÷ .24 = 5.9 = 6 trains.

Allow two trains for uneven spacing.

Total trains = 8.

Cars per train = 8.

Total cars required for service = 64.

Assume old equipment to be returned and improved equipment to be put on at $200 per car.

Cost improved equipment = 64 × 200 = $12,800.

Return on investment = 7,750 ÷ 12,800 = 60.5% per year.

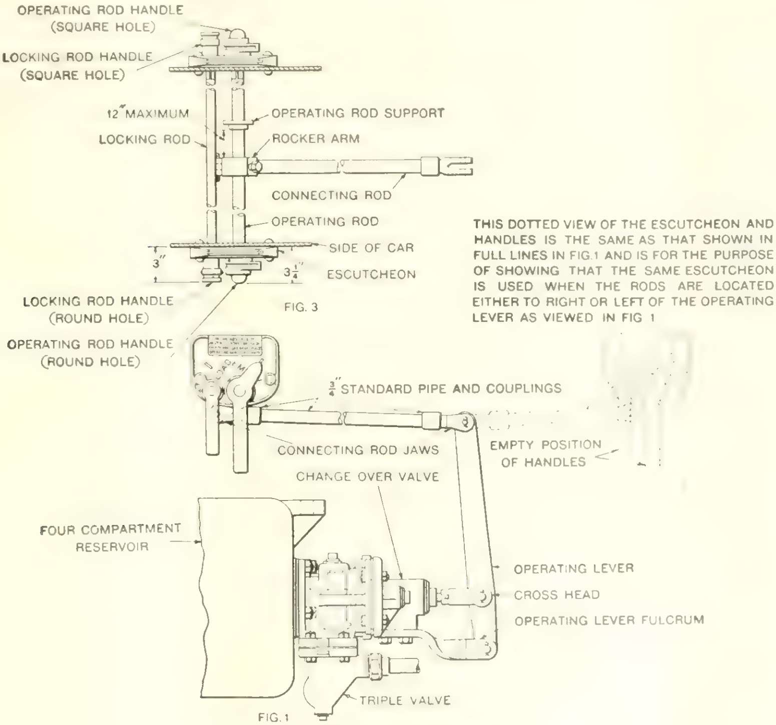
While these calculations assume certain conditons of operation, it must not be thought they are in any manner exceptional, for there is no operation but what can be improved in earning capacity to a greater or less degree by taking advantage of modern brake apparatus.

Empty and Load Freight Brake.

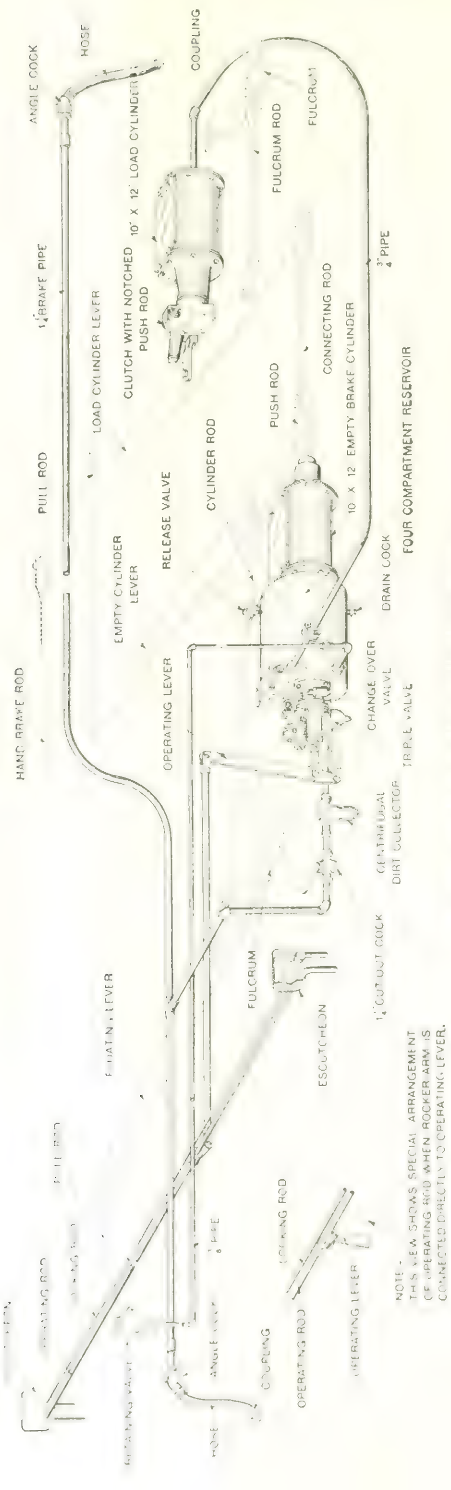
Almost two years have elapsed since we first announced the intention to describe the improvements made in air brake equipments, and all of this matter has related to steam and electric road passenger car brakes, but the development in air brakes has not been confined to passenger cars.

In many respects the freight car brakes have been improved upon to the same extent as the passenger brake, considering that there are but two sizes of equipment in general use, at least up to the point where electric control is added to the pneumatic brake.

The development of the type K triple valve has made possible the satisfactory operation of the brakes on 100 car freight trains and incidentally added a factor of safety to the control of trains on descending grades, but as the maximum braking



OPERATING MECHANISM.



effect of a freight car is limited to a certain percent. of the light weight of the car, the standard brake provides absolutely nothing in the way of an efficient brake for a loaded car, which has been the principal reason for the design and perfection of the empty and load brake for freight cars.

The use of large powerful locomotives has made it possible to haul long trains of cars up heavy grades, but in order to handle even moderate lengths of heavily loaded trains in descending heavy grades, it is frequently necessary to provide a higher braking power for the train than can be developed on heavily loaded cars by the standard brake alone. As a result it has been customary to divide the trains in sections in descending the grades and use hand brakes with the air brakes to assist in holding the train and sometimes empty cars have been hauled among the loads in order to increase the total percent. of braking power on the train, that is, the brakes on empty cars were utilized to assist in holding back the loaded cars.

Through a long series of trials, shop experiments and road service tests, the empty and load brake was developed to obviate the difficulties mentioned by providing a satisfactory brake for a loaded as well as an empty car.

The following issues will contain a complete description of this brake, which would require too much space for the present time, and as a preliminary the isometric view will show the general arrangement of the brake, and the following [illegible]

1. [illegible] "K" [illegible] volumes and cylinder. In addition to the quick service, retarded release and uniform recharge, this valve has an extra charging port (which is inoperative in empty position) so that when in load position, the reservoirs can be charged in approximately the same time as when in empty position.

2. [illegible] trolled by suitable rods and levers carried to each side of the car whereby the equipment may be placed in either the empty or load position, as desired by the trainmen. The change-over valve is manually operated for cutting to load position and automatically returned to empty position when the pressure in the system falls below 15 lbs.*

In order to provide for as quick a release of brake cylinder pressure in load position, the change-over valve has an extra exhaust port, as hereinafter described, which is inoperative in empty position.

*Note. If [illegible] the change-over [illegible] system falls below [illegible]

3. *Operating mechanism,* with a lever at each side of the car by means of which the equipment is set for either empty or load and may be locked in load position (providing the mechanism is provided with a locking lever).

4. *Empty brake cylinder* which operates to apply the brakes when the car is empty and to take up the slack [illegible] and deflection in the rigging, as explained later, when the car is loaded.

5. *Four compartment reservoir,* of either the combined or detached type, for the purpose of storing air for use in applying the brakes and to provide increased cylinder volume when the load cylinder is first brought into operation during an application, thus preventing a sudden increase in brake cylinder pressure.

6. *Load cylinder,* with notched push rod and enclosed locking mechanism, which operates to apply the brake shoes to the wheels in load position.

7. *Release valve,* attached to the reservoir, by means of which air pressure may be released from the reservoir when desired.

8. *Pressure retaining valve,* connected to the triple valve exhaust, by means of which the brake cylinders are permitted to exhaust freely to the atmosphere, or to retain a portion of the air in the brake cylinders when making a release in order to hold the brakes applied while recharging the system.

9. *Centrifugal dirt collector,* connected in the branch pipe as near the triple valve as circumstances will permit, for the purpose of preventing pipe scale, sand, cinders or foreign particles of any kind from reaching the triple valve.

10. *Angle cocks, hose couplings, cutout cock* and *flange unions,* the location and uses of which will be readily understood from the isometric piping diagram of the equipment. What this brake is intended for, and the results actually achieved are set forth in the following and just how it is accomplished will be shown through diagrammatic views in later issues.

1. Provides adequate braking power on a partially or fully loaded car, comparable with that obtained with the standard brake equipment on an empty car. This means that about three times as much braking power is made available on the *loaded* car as is possible with the standard form of brake.

2. Permits control of loaded cars to approximately the same degree as empty cars can now be controlled, thereby greatly increasing the factor of safety, particularly in grade work.

3. Provides uniform braking power throughout the train, thus eliminating shocks, break-in-twos, etc., with consequent damage to lading and equipment.

4. Provides means of air brake control for the very heavy, large capacity freight cars now being contemplated when the ratio of loaded weight is even more extreme than with cars heretofore common.

5. Enables the handling of a greater number of loaded cars down grades and so increases the traffic capacity and earning power of the road as a whole.

6. Permits the efficiency of the most powerful types of motive power to be utilized to the fullest extent because the longest train and heaviest tonnage than can be hauled up one side of the mountain may be readily controlled down the other side.

7. Furnishes maximum braking power with minimum air consumption, so that very little extra duty is required of the air compressor.

8. Returns *automatically* to empty position, unless locked in load position, when the pressure in the system drops below 15 lbs. This automatic change from load to empty position is an essential feature of this brake; otherwise, many slid flat wheels would doubtless result due to the apparatus being permitted to remain in load position inadvertently *after the load was removed.*

In addition, this equipment possesses the feature of interchangeability; that is, the operation of the apparatus, whether in empty or load position, is entirely harmonious with existing air brake devices and is operatively interchangeable throughout.

Brake Experiments on the Pennsylvania

It is interesting to observe that for several years past officers of the Pennsylvania Railroad have been disturbed by the difficulties of stopping passenger trains quickly and without jar. The new all-steel cars, each weighing 120,000 pounds, developed an entirely novel problem. Brakes that stopped a train of wooden cars running at 60 miles per hour in 1,000 feet would not stop a steel train of equal length in less than 1,600 feet. It was found to be of great importance that the stopping distance in emergency should be shortened, that the shocks and surges in the train be eliminated, and that a more responsive release action be obtained after a service application of the brake. It is believed that these modern problems have now been solved by the development of an entirely novel electrically actuated air brake.

The new brake reduces by 600 feet the distance in which a 12-car steel train going 60 miles an hour can be brought to a complete standstill—without jolting passengers.

The descriptions and analysis of the complete detail tabulations and diagrams fill a volume of over 400 pages, but it may be stated briefly that the shortest emergency stop of a single car, with no locomotive attached, running at 60 miles an hour, was made in 725 feet. This is [illegible] from a speed of [illegible] miles an hour was made in 1,422 feet. The [illegible] stop of a [illegible] from a speed of [illegible] an hour was made in 1,021 feet, and at a [illegible] miles an hour the [illegible] train was stopped in 2,197 feet.

The result has been that a more efficient form of brake attachment has [illegible] for designing brake shoes and rigging has been formed. The shoes and rigging of the various new designs are now being the subject of extensive laboratory tests, and the car equipment with the new improvement will be proceeded with as rapidly as possible in the near future on the entire system.

Of special interest is the fact clearly demonstrated that the tests show that the higher the speed of the train the less noticeable is the application of the brakes. The controlling factor proved to be the serial application of brakes such as prevails with the modern air brake equipment, yet with the electro-pneumatic brake insuring instantaneous application of all brakes on the train, there was no shock, except a very slight one in the first few cars on account of the low braking power of the locomotive. The cost of the experiments to date exceeds $50,000.

The trials covered three months. A total of 691 stops were made from varying speeds up to 80 miles [illegible] and with a test force of 45 observers, 160 separate records of data were made for each stop.

The enormous mass of passenger trains must be stopped many times on each run, and often, when confronted by a stop or signal or a train ahead, a matter of a few feet in their stopping distance is of very real importance. The air brake had itself made high-speed trains safe. It would not be feasible to run a train fast if in an emergency it could not be stopped quickly.

Having helped in the development of what seems the best, surest and safest air brake in the world, the Pennsylvania is sparing neither effort nor money to make certain that the brakes it uses will be operated with equal skill.

Education of trainmen in the construction and use of air brakes is most thorough and persistent. Large sums are expended for this purpose every year; the company has never kept a record of the exact time paid for to instruct its men. The teaching is just as practical as if given on an actual train.

The perfecting of the new air brake by the Pennsylvania Railroad marks a tremendous advance in this art. The steps leading up to that advance illustrates the refinements and the extraordinary character of the scientific experiments which must be made to achieve an important result in this highly complicated business.

New Car Shops of the Queen & Crescent Route

At Chattanooga, Tenn.

The main building of the Queen & Crescent route's new central passenger [illegible] been completed. Railroad insurance experts who have visited the building

VIEW OF MAIN BUILDING OF THE QUEEN & CRESCENT NEW PASSENGER CAR SHOPS AT CHATTANOOGA, TENN.

recently declare it is the only structure of the kind in the South. More than $65,000 has been expended on the main building, and the shops, when fully completed and equipped, will have cost more than $100,000.

The old Queen & Crescent car shops are housed in a wooden structure just west of the new building. The old shops can handle only three passenger coaches at a time, while the new building will house twelve of the longest modern coaches. Probably no building in the South is as completely fireproof as the new car shop building. The only inflammable material in the entire structure is the hardwood door to the foreman's office. The floor, walls and roof are principally of concrete, steel and glass. The main doors are of steel, and all the window sashes are steel. The panes are of wire reinforced plate glass. [illegible] size, contains 31,800 square feet of working floor space and four parallel railroad tracks between each pair of which is a supply car track. Ten thousand panes of glass in the roof and sidewalks afford 18,000 square feet of lighting space. The interior walls will be plastered and finished in white so that the lighting arrangements will possess about the same efficiency as that [illegible]

[illegible] under direction of J. F. Conerton, en- [illegible] and artificial lighting are by contract. Walls of the building were poured in forms which makes the main part of the building a single piece of concrete. Although comparatively isolated from public view by other structures in the large consolidated railroad yards, the building is artistically designed and would be an attractive addition to more accessible parts of the city.

The erection of the new passenger car shops means that most of the Queen & Crescent's repair work on passenger coaches will hereafter be done in Chattanooga. Its equipment will enable the railroads of the Q. & C. system to rebuild passenger coaches as well as remodel, repaint and refurnish them. Coaches seriously damaged by fire, wrecks, hard wear and rendered obsolete by time, will be restored to up-to-date, serviceable condition. The capacity of the new shops being four times that of the old establishment will cause the railroad company to make a corresponding increase in the number of mechanics employed.

[illegible] CAR SHOPS OF THE QUEEN & CRESCENT [illegible]OOGA, TENN.

Small Mazda Lamps.

The distinctive features of the concentrated filament Mazda lamps of high wattages have proved so popular that the Edison Lamp Works of the General Electric Company has developed vacuum Mazda lamps of similar appearance in the 25, 40 and 60 watt sizes. This concentrated filament construction gives greater vertical distribution of light than the regular Mazda lamps of corresponding wattages. The new lamps will, therefore, be employed where natural distribution of light downward is required. They can be used in existing sockets and fixtures. These lamps will be made in the same sized bulbs as the corresponding regular Mazda lamps, will have the same spherical watts per candlepower efficiency and will have a rated average life of 600 hours.

Angus Sinclair on Smokeless Firing

Remarks at the Convention of the Traveling Engineers' Convention

At last convention of the Traveling Engineers' Association a report was presented on Smoke Prevention, which excited much discussion:

Dr. Angus Sinclair (RAILWAY AND LOCOMOTIVE ENGINEERING) said: "I am a pioneer in regard to the efforts toward smoke prevention. I have gone through a great deal of experience and some of that experience has been highly varied, to say the least. It seems very strange to see one road burning the same kind of coal as another and making clouds of black smoke all the time, while the other makes very little, and hear the officials saying, 'Well, we do the best we can.'

"I was a youth with Thomas Yarrow at Arbroath in Scotland, the locomotive superintendent who first applied the brick arch to a locomotive fire-box, and then I got to firing and running engines like the others, I was required to get along without smoke. But in all my experience there never was anything needed besides the brick arch and a careful fireman. A careful fireman always comes in if you are going to have proper combustion of fuel made a success.

"I began running in this country about 1876, and one of the first things that struck me was the careless way the firing was done. In the first place the enginemen paid no attention to the saving of coal. They would have a great mass of coal tumbling off the side of the tender all the time and pay no more attention to it than if it were worthless gravel. The men just followed the practice that had been common before their time. It had been only a few years since the change was made from wood burning to coal burning and the railway companies seemed to think it was entirely unnecessary to give the men any instruction about how coal should be burned. A similar loose system that has prevailed to a great extent over all the railroads on the American continent. A new device would be brought in and given to the engineman. If he made good use of it, all right; if he did not it was all right, too. I do not think there has been so much total ignorance, gross ignorance in the management of railway mechanism anywhere as there has been in the United States, and that was the case with coal burning and smoke. All the men were required to do was to make steam if they could, and whether they made smoke or not was of no consequence.

"I had a fireman who followed just the standard practice. I know it was the standard practi[illegible]ited States for I had observed it on many railroads. The fireman would fill up the firebox until the coal was comfortably near the door. Then he would climb up to his seat and stay there and keep an eye on the smoke stack. As soon as the smoke began to clear off a little he would step down and throw in a few more shovels of coal. That was the standard method of firing, and it is by no means unknown today.

"I said to my first fireman, after he had been firing for me a few days, 'Don't you think it would be a good plan to get along with less smoke?'

"'Less smoke? What difference does it make? It doesn't do the engine any harm, does it?'

"'Well,' I said, 'it doesn't look very well.'

"'Oh, h—— with looks! The engine goes along and steams. That is all I need to care for.

"I said, 'I have been accustomed to running engines without causing smoke and I think you might try it.'

"'Now,' he said, 'look here. I have learned to fire this engine and I can fire it and make steam, and I am not going to have any d—— foreigner come and tell me how to do the work.' He did not fire for me another trip.

"Well, I persisted in having the firing done according to my ideas and I practiced what became known as the three scoop firing on the road where I was. I recommended that they fire three scoops at a time. (The system was described in my book, Locomotive Engine Running.) I told them they would get along that way and make steam without making much smoke and they began talking about that as my system. I wrestled with the firemen to some extent and some of them dropped into my way and thought it was pretty good practice to do their work properly. You see it is a question of doing their work properly. If a man does not care a cent how his work is done, and is just as proud of poorly done work as of well done work, you cannot do anything with him; but I used to talk to the firemen and say, 'You will find that if you fire carefully, fire, say to produce smokeless firing, you will use less coal and consequently you will be interested in that way. You will not have to shovel so much coal in the course of the trip.' Two or three of them were willing to follow my practice and that was all lovely, but there was no general sentiment in favor of it.. Most of the trainmen sneered at me for having introduced such [illegible]

"I went away then after a while. I went into newspaper work and I did not let the subject of proper firing drop. I kept it before the railroads in type if not with the shovel, so that the system became pretty well known. One day the general superintendent of my old road wrote to me, saying, 'We decided to follow your system of firing and it is going splendidly. If you will come out and see it we shall be very glad to have you, and I feel sure you will be interested. The men are all interested in it.'

"So I went to Cedar Rapids, and they certainly were making a fine job of smokeless firing. They were following a one scoop system, which they were at perfect liberty to do; but some one called it the Sinclair System and I did not want that, I was satisfied with the three scoop system. However, it worked all right.

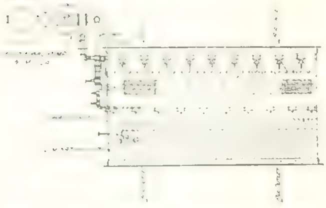
"I had become proprietor of LOCOMOTIVE ENGINEERING by this time, and when I went back to New York I wrote an account of what I had seen at Cedar Rapids, wrote a plain statement of facts about how the men were firing without causing any smoke, and estimated the saving of fuel that resulted to be about 25 per cent. The men on the Cedar Rapids road seemed to be happy in that. There appeared to be no objection against it. So I published the descriptive article. I happened to do it in December, when we receive the greater part of subscription renewals and I lost about 5,000 subscribers on account of that article. Mr. Conger, your past president, was my agent at the time and he said there was not a traveling engineer in the country but what was against the advocacy of smokeless firing. He thought I had made a very bad mistake in publishing that article. However, it did not ruin me. I got over it after a while, but that is the thanks a man gets for being a pioneer in any important reform

"The action of the Burlington, Cedar Rapids and Northern Railway in introducing Sinclair's system of Smokeless firing, led a great many other railroad companies to try the same system. It gradually became popular and the demand arose for proper methods of firing. The saving of fuel effected by this improved practice of firing has saved to railroad companies the expense of millions of tons of fuel. Mr F. D. Underwood, President of the Erie Railroad, is the only official who has displayed appreciation of the educational work accomplished."

Electrical Department

Cooling Air for Large Electric Turbines.

[illegible]



[illegible] AIR WASHER AND COOLER.

electric current through the windings. In fact it is very essential with large machines to fully ventilate the electric generator so that the air will pass to all parts of the windings as otherwise there may be "hot spots" causing the generator to burn out. The larger the generator the more care must be given to this point.

As it is essential to get this air circulation the common practice is to build a large duct which will draw the air from some adjoining room to the main room of the power house and lo- [illegible] that the air is drawn in, by the high speed of the generator, at the bottom of the generator frame, and discharged at the top. Due to the air being heated as it passes through the generator there is created a natural draft, aiding the circulation of air created by the revolu- [illegible]

Large generators take large volumes [illegible] cu. ft. of air per minute and even with cheese cloth across the opening of the duct, this large volume of air carries considerable dust with it which after a few weeks operation will fill the air [illegible]

The latest and best apparatus for [illegible] "Spray Type Air Washer." This washer will remove 98 per cent. of the dust [illegible] the [illegible] to the wet bulb temperature of the air entering the washer. The cooling of the air is of great importance as the cooler the air the more electric power that can be taken from the generator. [illegible] hot weather. The extent to which air [illegible] 95 deg. Fahr. a generator can carry only 79 per cent. of rated load, whereas if the air temperature is 77 deg. the machine could carry full load, an output [illegible] 20 per cent. [illegible] tioned above the cooler will cool to the wet bulb temperature [illegible] with the temperature of 95 the wet bulb would be approximately 75° or 76°.

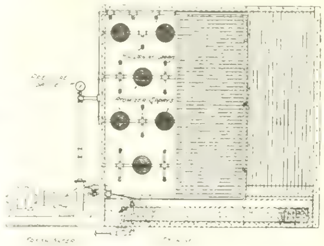
The construction of the air washer is as follows: [illegible] 20,000 H.P. the opening of the washer would be 17 ft. long, 4 feet high and its depth would be 6 feet. As the air is drawn through this opening it is subjected to a fine, dense mist of water which is formed by means of a series of spray nozzles located at the very front of the opening of the washer. Across the compartment in front of the nozzles is a wire screen which breaks the spray and causes the water to drop in a sheet across the air current. Back of the screen are baffles which separate the water from the air. The water which drops into the bottom of the washer is withdrawn and circulated through the nozzles, a settling basin being provided to collect the dirt [illegible] hed out of the air. Unassisted by a ventilating fan, the water jets alone [illegible]

Electric Drive for Dreadnoughts.

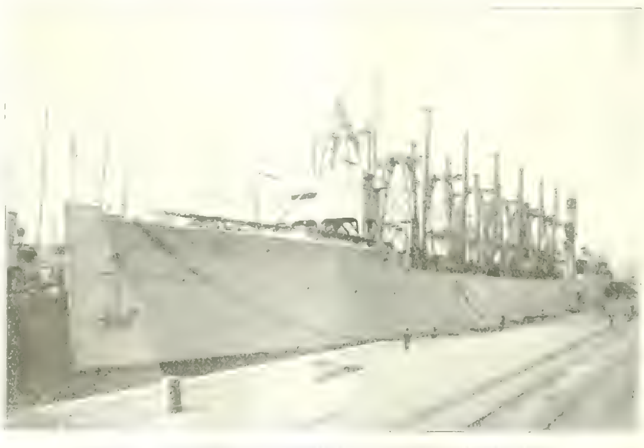
All ships up to ten years ago were propelled by reciprocating engines. At that [illegible] introduced and the results were so [illegible] reciprocating engine was over but great improvements were made in the former [illegible] so that both of these types have been and are used with success.

A third method has now come to the front: the electric motor, and it remains to be seen whether still further improvements in the reciprocating engines and turbines will be made. The U. S. Collier Jupiter has been equipped with motors for driving the propellors during the past two years and observations have shown the method to be thoroughly practical, so good, in fact, that the same system will be used in the dreadnought [illegible] to be constructed at the Brooklyn navy yard.

The use of motors does not mean that boilers and coal are to be dispensed with. Electric current is needed to drive the motors and a power plant, consisting of boilers, coal, turbines, etc., are essential. [illegible] propeller [illegible] will be connected to the motors instead of direct to the engine [illegible] which are



THREE SECTION ELEVATION, SPRAY TYPE AIR WASHER AND COOLER.



[illegible] ELECTRICALLY PROPELLED COLLIER.

derived from electric drive in industrial installations are applicable here.

From good authority the electric equipment for steamship work is more reliable; it affords better maneuvering qualities, it more economical, requires less space, is lighter in weight, and is more easily cared for and repaired.

The most important of the above advantages in connection with a battleship is the first, reliability. The illustration as planned for a battleship is duplicate throughout, so that the breaking down of one engine does not effect the ship except at high speed. If one turbo-generator should break down all of the motors can be run from the other and at least a speed of 19 knots be obtained. This would be impossible with the other methods as the breaking down of one engine results in the loss of one propeller a great handicap.

In turbine-driven installations the turbines must be reversed for "backing" and operating engineers believe that there is a slight distortion which causes blade trouble. With the electric motor installation the steam turbine would always operate in one direction and the electric motor be reversed. In this way full power would be available for the astern direction.

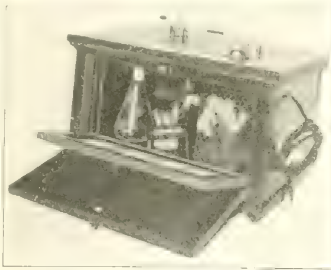
Easily handled switches replace the heavy throttles. In rough sea there is no engine racing as it is easily arranged to maintain accurate speed of the motor.

The Jupiter is 542 feet long, draught 27 feet 8½ inches, and has a displacement of 19,300 tons. She was designed for a speed of 14 knots developing 5,500 shaft horsepower. Each motor, of which there are two, is of 2,750 horsepower. In the case of the dreadnought California there will be two generators and four induction motors. In case of breakdown of one generator, all four motors would receive current from one generator.

An Electric Bacteriological Incubator.

Until recently bacteriologists have depended upon gas-heated devices when studying bacteria, but now a much superior piece of apparatus is available, namely, an electric incubator. The electrical apparatus is now generally used on account of the uniform temperature regulation obtained. When once adjusted to the desired temperature, it is claimed, it will operate for days at a time without any attention. The incubator is heated with electric resistance coils in the top of the device. A thermostat inside the machine expands with rise in temperature and pushes a piston stem which raises and lowers a balanced lever arm carrying two electric contact points. These two points dip in mercury cups and when lifted out the electric circuit is opened and current is cut off from the resistance. When the temperature falls just a small fraction of a degree, the contact points are lowered back into the mercury and the electric circuit is closed. A variation of less than 1/10 of a degree is possible.

The incubator consists of a double-walled box having a ½-inch air space between the outer and inner walls. Double doors are provided, the inner one having a glass panel enabling the contents to be inspected without opening the door.



INCUBATOR WITH DOORS OPEN.

The Purchasing Value of a Cent.

The New York Edison Company is one of the largest electrical companies in the United States, and supplies electric lighting and power for the greater part of Manhattan, New York City. All kinds of electrical appliances are now on the market enabling the housewife to prepare foods at a minimum amount of trouble and cost. The Edison Company recently advertised "The Purchasing Value of a Cent" as follows: One cent will buy Edison service:

To light a 40-watt lamp (36 candle power) for 2½ hours.

To make 12 cups of coffee in an electric coffee pot.

For 5 bottles of milk in a nursery milk warmer.

For 500,000 stitches on a motor driven sewing machine.

To brew 12 cups of tea in an electric samovar.

To operate an electric chafing dish for 15 minutes.

To boil 12 eggs in an electric hot-water cup.

To operate an electric vacuum cleaner for one hour.

To warm a heating pad for one hour.

To run an electric washing machine for one-half hour.

To operate an electric flat iron for ten minutes.

To make 22 slices of toast on an electric toaster.

Geese Crossing an Electric Railway.

When the electric street railway was first opened in Baltimore, the conducting rail was left exposed, the engineers thinking there would be no danger to life from the low tension current employed. There appeared to be no danger to human life, and little inconvenience to persons who [illegible] than the most [illegible] of the lower animals are much more susceptible to electric shocks than human beings, and there were many amusing sights seen among animals that received shocks from the current. Horses and pigs were very sensitive to the electricity and manifested stirring emotions under its influence. But the most entertaining sight was when a flock of geese came waddling along and touched the rail. The leader proceeded unconcernedly until he raised one foot upon the rail, when he sprang back with a wild quack and indignant stare to find out what had committed the outrage upon his dignity. Seeing nothing that he could reasonably blame, he would utter some voluble remarks in which he would be joined by a chorus of the whole flock. Then he would make another start and again get in touch with the electric current, when he would tumble backward screaming and quacking, all his companions joining in to swell the tumult. They would keep uttering the wildest noises for a few minutes, running hither and thither in search of something to pour their wrath upon but carefully avoiding the rail. After tiring of this performance, they flew off in a body, screaming their fiercest notes of defiance and contempt, but that same flock of geese would never again be seen waddling over the electric railway.

Locomotive Engineers' Insurance

Although there is a good and reliable insurance department connected with the Brotherhood of Locomotive Engineers, membership in the insurance is not compulsory, and many members fail to carry insurance, which is a scandalous neglect of family responsibilities. Vigorous efforts have been made at various times to make membership in the insurance compulsory with all members of the order, but such a wise rule has never been carried out.

In spite of the hazardous nature and the good pay, most of the engineers receive as a rule, there are many of the members who carry no insurance whatever, and the members of the Brotherhood are habitually solicited to extend aid to widows and orphans of men who have neglected to make provision for families that have been suddenly left destitute. We hope the policy of this strong organization towards making insurance compulsory will soon meet with a better fate than it has in the past.

Flash Light Signals on the Boston & Maine.

[illegible] & Maine [illegible] flashing acetylene lamps on signals experimentally for nearly two years, now has these lamps in use on about ten miles of its line, from Parkway Bridge, Mass., to Reading Highlands, on the Portland division.

New Type of Powerful Milling Machine

[illegible] the Garvin Machine Co., Spring and Varick streets, [illegible] their popular size No 21 plain milling machine. The machine known as the [illegible] parts which [illegible] L. & S. [illegible] the cone pulley shaft; the change being effected by operating a handle, which [illegible] eccen[illegible]

[illegible]

[illegible] continuous work. The [illegible] machine is closed or solid, thus joining the arm and spindle bearings rigidly to[illegible] This construction insures great rigidity and freedom from vibration. The drive to the spindle is from a three step cone [illegible] 5¼ to 1. The cone pulley takes a 4-inch [illegible] into mesh with the gear on the back shaft there is a corresponding increase in feed. The feeds vary from 1/200 to ¼-inch per revolution of the spindle; change gears being provided to cover this range. The feed is transmitted to the large work table by a steel nut, which rotates on a stationary screw. The rotary feed nut is directly driven by hardened steel worm gear and worm running in oil. The large [illegible] the rotary nut through spiral gears running in oil, is for feeding the table by hand. The feed box is built into the saddle, so that the stresses are taken in the most direct manner. The number of joints is reduced to a minimum. The saddle is massive and has a micrometer adjustment. The knee is of the Garvin closed type top construction, and is adjusted vertically by a micrometer hand wheel and screw, which does not pass through the floor. The overhanging arm is exceptionally large and the braces connect the saddle and arm, leaving the yoke free to be adjusted to suit the arbor and position of the cutter. All gears are protected as the illustration shows.

Price Reductions in Edison Mazda Lamps.

Practically all the sizes and types of Edison Mazda multiple lamps are affected by reductions in list prices that were put into effect April 1, 1915, by the Edison Lamp Works of General Electric Company. On the regular straight side and round bulb lamps, from the 10-watt to the 250-watt sizes, also on sign lamps, stereopticon lamps, etc., the reductions range from 3 to 20 cents per lamp, according to the size. These reductions, which average about 10 per cent., will tend to popularize further the already popular lamps.

The new concentrated filament vacuum lamps of 25, 40 and 60 watt sizes now list at only 5 cents per lamp more than the regular lamps of corresponding sizes.

On the gas-filled, multiple lamp of 100 to 1000-watt sizes, the reductions range from 50 cents to $1.00 per lamp, the average reductions being between 20 and 25 per cent. The introduction of gas-filled lamps has been exceptionally rapid. Over a million are already in use. The decreased cost of these lamps will undoubtedly result in a still more rapid replacement of vacuum lamps by the more efficient gas-filled units.

Reported Large Contract from the Russian Government.

New York papers give currency to a rumor that the New York Air Brake Company has taken an order from the Russian government for $12,000,000 worth of appliances and machinery, and that Russia has deposited as security $3,000,000 in New York and advanced $400,000 for the purchase and installation of special machinery required for the manufacture. Other orders of even larger magnitude are reported to be already contracted for by American manufacturers.

Origin of Traveling Engineers.

By J. F. De VOY, Superintendent of Motive Power, Chicago, Milwaukee & St. Paul Railroad.

At the opening of the la[illegible] Traveling Engineers' Convention, Mr. J. F. De Voy, assistant superintendent of motive power, Chicago, Milwaukee & St. Paul Railroad, delivered an address of welcome that contained more words of wisdom than such addresses are usually noted for. Skipping some valuable statistics concerning railroad operation, Mr. De Voy said:

It was about twenty-five years ago that traveling engineers were first used in this section of the country. Operating conditions then were rapidly changing, due to changes from small to larger power, larger and more trains operated over the same track, capacity and weight of cars increased, and new appliances put into use. The air brake was being rapidly developed into a highly sensitive and complicated apparatus; improved injectors, lubricators, sundry devices and other auxiliaries were being introduced; while the responsibility for the handling of a train was gradually placed entirely with the man on the head end.

The change from a few to many enginemen on any specified division, brought about a condition where it was impossible for the master mechanic and the superintendent to come into as close contact with the individual engineman as was necessary for economical and safe operation. There was a gradual drifting apart, or widening of the gulf between the enginemen and their immediate superiors, the master mechanic and the superintendent. These conditions were responsible for the creation of the office of traveling engineer.

At first the duties of traveling engineers were not well defined, but after a time it became very apparent that it was necessary to leave to these new officials several duties that had previously been handled by other officials. On some roads this office has been developed until the title of "Traveling Engineer" would not fit in with the duties of the position and they have more properly applied the title, "Road Foreman of Engines."

In looking over the requirements and duties of traveling engineers on the various roads, I find there is a lack of uniformity as to just what is required of a traveling engineer. In general they are expected to instruct new men, to correct the faults of those longer in the service, to investigate cases of improper work, to investigate failures in the service over which enginemen themselves have no control, to observe and report on the operation of new devices and special equipment and to report on [illegible] with respect to its ability to handle any particular service.

In order for an engineer to become a successful traveling engineer, he must be able to do many things well, that are not required of a man running an engine. The motive power officials who have the selection and appointing of traveling engineers, must give the question a great deal of thought in order to get men for the place who will be able to do the work in a satisfactory manner. The man selected must himself be capable of doing what he expects the enginemen to do in a manner which will not tend to antagonize the enginemen, but to obtain their best possible efforts. He must be a man in whom his superior officers have absolute confidence, so that when he makes a report, it will be received as final.

Opinions differ as to the territory, the number of engines and men which should be assigned to any one traveling engineer. There are two extremes. One is a case where there is one traveling engineer for a number of divisions with so many men that a traveling engineer never becomes thoroughly acquainted with but few of them. In such cases, there is usually so much special work to do: looking after new equipment, working on the most important trains, that the traveling engineer has very little time to ride with and instruct the men who are often very much in need of instruction. The other extreme is where the assignment is such that the traveling engineer can ride with every crew at least once a month. I know of many instances where enginemen have been performing unsatisfactorily day after day and their poor performance would have been changed into good work had a wise traveling engineer been able to ride with them occasionally.

A traveling engineer should be allowed a great deal of latitude in selecting the men he rides with. He should keep in touch with the train dispatcher, with the round house foreman and the round house force, and when he finds an engine which requires attention he should see for himself that the work is done. It has been said that the roundhouse foreman and the train dispatchers run the railroads. It is true that what a good trainmaster is to the operation department, a traveling engineer is to the motive power department. Show me a railroad company which has first class men for train dispatchers, train masters, traveling engineers and [illegible] will show you a railroad which is being operated safely and economically.

Writers concerning industrial development have been in the habit of giving Englishmen the credit for nearly all important inventions that have promoted the mechanic arts, although in numerous cases the inventions originated in other countries. The slide rest, which did so much to improve the efficiency of the engine lathe, was invented by Holtzapffel, a German tool maker, but all English writers attribute the invention to Henry Moriarty. The hydraulic press was invented by the South American, but British writers credit the invention to Joseph Braham, who merely imitated the American invention without credit.

The building of railway machinery gave the first great impetus to machine tool making in the United States. British tools were at first imported and became patterns from which our machine tools were made, but like the builders of locomotives, American machine tool makers soon displayed original ideas, and they have so perfected their products that they are now regarded as the best machine toolmakers in the world, and toolmakers of other countries honor them by imitation.

We receive complaints occasionally that some of our articles are beyond the comprehension of certain readers. We publish articles only which we think within the mental grasp of ordinary workmen, plain English articles that every person having received a common school education will understand. If a reader is interested in any subject and has difficulty in understanding some parts, he is likely to study them, and in so doing will acquire knowledge that he did not possess [illegible]

There is less accurate information than might be expected concerning the wear of brake shoes. Some years ago a friend of the writer made tests on a car of a certain train to find out data about the wear due to the work of stopping the train. The car weighed 44,000 pounds and was run about 30 miles an hour, and eight brake shoes were employed to do the work of stopping. When applied the brake shoes weighed 176 pounds and they were removed after making 1,648 stops. The reduction of metal was 140 pounds.

In our writings relating to combustion and other scientific subjects, it is sometimes necessary to mention heat units. A correspondent reminds us that we ought to employ the abbreviation B.t.u. for the heat unit which means, spelled out, British thermal unit. As the American heat unit is the same as the B.t.u., we do not [illegible] tity of heat required to raise the tempera- [illegible] its greatest density is the same unit of [illegible]

Items of Personal Interest

[illegible] appointed master [illegible] Terminal, with [illegible].

Mr. J. R. [illegible] appointed master mechanic of the Western Pacific, [illegible].

Mr. F. J. [illegible] has been appointed general foreman of the Pere Marquette, with office at Chicago, Ill.

Mr. J. [illegible] has been appointed general safety agent of the Union Pacific with office at Omaha, Neb.

Mr. C. E. Lester has been appointed master shop foreman of the Lehigh Valley, with office at Sayre, Pa.

Mr. J. J. Holt has been appointed locomotive foreman of the Great Northern, with office at Sandstone, Minn.

Mr. J. Peckley has been appointed road foreman of engines of the Lehigh Valley, with office at Wilkes-Barre, Pa.

Mr. E. F. Foster has been appointed general foreman of the Bangor & Aroostook, with office at Oakfield, Me.

Mr. Wirt Parker has been appointed master mechanic of the Gulf & Sabine River, with office at Fullerton, La.

Mr. C. Ransel has been appointed master car painter of the Chicago, Burlington & Quincy, with office at Aurora, Ill.

Mr. W. C. Dean has been appointed traveling engineer of the Bangor & Aroostook, with office at Derby, Me.

Mr. K. H. Martin has been appointed general equipment inspector of the Southern, with office at Washington, D. C.

[illegible] N. Ball [illegible] has been appointed general foreman of the Detroit, Toledo & Ironton, with office at Delray, Mich.

Mr. Otto J. Protz has been appointed shop foreman of the Chicago & Northwestern, with office at Wyeville, Wis.

Mr. A. M. Phelan has been appointed locomotive foreman of the Great Northern, with office at New Rockford, N. D.

[illegible] has been appointed general foreman of the Atchison, Topeka & Santa Fe, with office at Deming, N. M.

Mr. C. Kyle has been appointed master mechanic of the Atlantic division of the Canadian Pacific, with office at St. John, N. B.

Mr. T. G. Evans has been appointed general foreman of the Atchison, Topeka & Santa Fe, with office at Las Vegas, [illegible]

[illegible]

& Great Northern, with office at Palestine, Tex.

Mr. M. S. Ransom has been appointed general foreman of the Nashville, Chattanooga & St. Louis, with office at Atlanta, Ga.

Mr. J. A. Long has been appointed acting general foreman of the Missouri, Kansas & Texas, with office at Greenville, Tex.

Mr. W. A. Barnes has been appointed road foreman of engines of the Chicago, Burlington & Quincy, with office at Ottumwa, Ia.

Mr. L. Atwell has been appointed general foreman of the Southern, with office at Selma, Ala., succeeding Mr. T. S. Krahenbuhl.

Mr. J. K. Brassell has been appointed superintendent of motive power of the Northwestern Pacific, with offices at Tiburon, Cal.

Mr. C. A. Loudin has been appointed road foreman of engines of the Chesapeake & Ohio Southwestern, with office at Washington, Ind.

Mr. J. W. Hager has been appointed locomotive and fuel inspector of the Nashville Chattanooga & St. Louis, with office at Nashville, Tenn.

Mr. F. B. Farrington has been appointed general foreman of the Pennsylvania, with office at Bradford, Ohio, succeeding Mr. C. W. Kinnedi.

Mr. George H. Laycock has been appointed locomotive foreman of the Grand Trunk Pacific at Endake, B. C., succeeding Mr. George McNeil.

Mr. A. E. Dales has been appointed district master mechanic of the Canadian Pacific, with office at Brandon, Man., succeeding Mr. L. G. Fisher.

Mr. B. Trentman has been appointed foreman of repairs on the Delaware & Hudson, with office at Oneonta, N. Y., succeeding Mr. E. Jones.

Mr. C. Taylor has been appointed general foreman of the car department of the San Antonio, Uvalde & Gulf, with office at Pleasanton, Tex.

Mr. William H. Murray has been appointed foreman of the Oregon Short Line, with office at Montpelier, Ida., succeeding Mr. W. C. Burel.

Mr. E. B. Van Akin has been appointed road foreman of equipment of the Minnesota division of the Rock Island Lines, with office at M[illegible].

Mr. J. W. Johnson has been appointed master mechanic of the Arkansas, Louisiana & Gulf, with office at Monroe, [illegible] succeeding Mr. J. T. Tadlock.

Mr. V. H. McGinnis has been appointed traveling engineer of the Denver & Rio Grande, with office at Grand Junction, Col., succeeding Mr. A. G. Titus.

Mr. W. P. McDevitt has been appointed master mechanic of the Kentucky & Indiana Terminal, with office at Louisville, Ky., succeeding Mr. John F. Newhouse.

Mr. W. B. McNiece, formerly car foreman of the Grand Trunk Pacific at Jasper, B. C., has been appointed car foreman on the same road, with office at McBride, B. C.

Mr. W. C. Burel, formerly district foreman of the Oregon Short Line at Montpelier, Ida., has been appointed general foreman on the same road, with office at Salt Lake City, Utah.

Mr. O. Blodd, formerly general foreman of the car department of the New York Central Lines at Wesleyville, Pa., has been transferred to Sandusky, Ohio, as general car foreman.

Mr. H. Selfridge, formerly general foreman of the Oregon Short Line at Salt Lake City, Utah, has been appointed master mechanic of the Nevada Northern, with office at East Ely, Nev.

Mr. G. Haven Peabody, western representative of the Lima Locomotive Corporation, Lima, Ohio, has resigned, effective April 15, to accept a position with the Lackawanna Steel Company.

Mr. P. P. Mirtz has been appointed assistant engineer of the equipment department of the New York Central, with office at New York, N. Y. He will superintend locomotive design and specification.

Mr. H. E. Smith has been appointed chemist and engineer of tests of the New York Central, with office at Collinwood, Ohio. He will have supervision of laboratories and inspection of material.

Mr. R. W. Stevens has been appointed general superintendent of the Chicago & Western Indiana, with offices at Chicago, Ill. His jurisdiction includes operating, maintenance and mechanical matters.

Mr. T. Spence, formerly car foreman of the Canadian Pacific at Fort William, Ont., has been appointed general car foreman at Vancouver, B. C., on the same road, in place of Mr. W. C. Hodgson.

Mr. John McRae, formerly locomotive foreman of the Canadian Pacific at Revelstoke, B. C., has been appointed shop foreman on the same road, with office at Kamloops, B. C., succeeding Mr. G. Dillard.

Mr. L. S. Hungerford has been elected general manager of the Pullman Car Company, and Mr. Richmond Dean and Mr. Le Roy Kramer, vice-presidents;

Mr. Clyde Reynolds, assistant to the president.

Mr. R. M. Brown has been appointed assistant engineer of the equipment department of the New York Central, with office at Cleveland, Ohio. His duties will embrace engineering and drafting of locomotives and car shops.

Mr. W. L. Connors, general signal foreman of the Buffalo, Rochester & Pittsburgh, has been appointed signal supervisor on the Rochester division of the same road, with office at Warsaw, N. Y., succeeding the late Mr. M. J. Brundige.

Mr. A. F. Caskey has been appointed road foreman of equipment of the Des Moines Valley division of the Rock Island Lines, and that part of the Dakota division between Valley Junction and Gowrie, with office at Valley Junction, Ia.

Mr. William H. Kinney, formerly master mechanic of the New York, Ontario & Western, at Carbondale, Pa., has been

WALTER ALEXANDER

appointed to a position in the sales department of the Dearborn Chemical Company, Chicago. Mr. Kinney's office will be in New York, N. Y.

Mr. E. H. Morey, formerly shop demonstrator and chief instructor of the Chicago & Northwestern, has [illegible] foreman of the new erecting and machine shop at Chicago, Ill., and Mr. E. Bloom has been appointed to the vacancy caused by the promotion of Mr. Morey.

Mr. William Pelham, formerly master carpenter of the Erie, at Marion, Ohio, has been appointed inspector of bridges and buildings on the same road, with office at Cleveland, Ohio, and Mr. J. Orcutt has been appointed master carpenter at Marion, succeeding [illegible]

[illegible] general foreman of the car repairs on the Charlestown and Western, at Augusta, Ga., succeeding Mr. W. F. Weigman, resigned, to accept a position with the Seaboard Air Line, as general foreman of the car department at Portsmouth, Va.

Mr. H. H. Seabrook, formerly district manager of the Metropolitan Electric & Manufacturing Company in Baltimore, has been appointed district manager of the company at Philadelphia, in place of Mr. J. J. Gibson, who has been appointed foreman of the tool and supply department of the same company at East Pittsburgh, Pa.

Mr. C. A. Paquette has been appointed chief engineer on the Cleveland, Cincinnati, Chicago & St. Louis, in place of Mr. G. P. Smith, who has been appointed consulting engineer on the same road, with headquarters at Cincinnati, Ohio, and Mr. Hadley Baldwin has been appointed assistant chief engineer, also with office at Cincinnati. Mr. Paquette will have charge of construction and maintenance, and the office of chief engineer of maintenance of way has been abolished.

Mr. B. H. Bryant, Civil Engineer, has returned from Guatemala, Salvador and Honduras, where he had been locating railroad lines as Chief Locating Engineer of the International Railways of America, and is taking a much needed vacation in Washington, D. C. Mr. Bryant, who has acted in the capacity of Division Engineer, Chief Engineer, Construction Engineer, and General Superintendent of steam railroads in the United States, Canada, Mexico, Brazil and South American countries, for many years, is well known among railroad men. He expects to return to active work next month.

Mr. Philip W. Moore has been elected president of the National Railway Appliance Association; vice-president, Mr. H. M. Sperry, General Railway Signal Company, Rochester, N. Y.; treasurer, Mr. C. W. Kelly, Kelly-Derby Company, Chicago, Ill.; director, Mr. R. C. Jacobi, Johns-Manville Company, Chicago; director, Mr. R. C. McCloy, Wm. Wharten Company, Philadelphia, Pa. The directors continuing in office are Mr. E. H. Bell, Railroad Supply Company, Chicago; Mr. J. Alexander Brown, Pocket List Company, New York, N. Y.; Mr. E. E. Hudson, Thos. Edison Company, Orange, N. J., and Mr. M. J. Trees, Chicago Bridge & Iron Works.

Mr. Walter Alexander, formerly district master mechanic of the Chicago, Milwaukee and St. Paul, at the West Milwaukee shops, has been [illegible] as one of the State [illegible] Railroads in Wisconsin. Governor Philipp, himself [illegible] ing and experience [illegible] der because of his [illegible] knowledge. [illegible] himself for [illegible] machinist. He was for five years in[illegible] structor in [illegible] sity of Wisconsin, before returning to railroad work. The appointment is welcomed and approved by all concerned in railroad welfare. A large majority of the railroad commissioners should consist of men trained in the practical conduct of railroad affairs, as no other kind of men are qualified to represent the people in promoting, encouraging and regulating the development of the country's transportation agencies.

OBITUARY.

William McIntosh.

We regret to announce the death of Mr. William McIntosh, formerly superintendent of motive power of the Central Railroad of New Jersey. The sad event occurred at his home at Plainfield, N. J., on March 15, in the sixty-sixth year of his age. He was a native of Franklin, Quebec, and entered railway service in the employ of the Chicago, Milwaukee &

WILLIAM McINTOSH

St. Paul, and served a regular apprenticeship as machinist, and latterly was engaged as fireman and locomotive engineer. Latterly he served several years as locomotive engineer on the Chicago & Northwestern and was foreman of locomotive repairs on the same road at Wareco, Minn., and was appointed master mechanic on the same road at Winona, Minn., in 1887, remaining in that position until 1899, when he resigned to accept the position of superintendent of motive power on the Jersey Central. He retired on account of failing health in 1909. He perfected many improvements in locomotives and car construction, and was a very accomplished mechanical railway man. He was prominently identified [illegible] and was elected president of the American Railway Master Mechanics' Association. [illegible] disposition, he was much esteemed by all who had the honor of his acquaintance.

Association Meetings and Annual Conventions

Railway Supply Manufacturers' Association.

The Railway Supply Manufacturers' Association will hold its annual convention this year during the week June 9-16, in conjunction with the conventions of the American Master Mechanics' Association, and the Master Car Builders' Association at Young's Million Dollar Pier, Atlantic City, N. J. The first assignment of spaces for the railway exhibits took place in February, and indications are that the exhibit will be the largest and most interesting hitherto made. Some spaces are still open, and those desiring to exhibit and to whom spaces have not yet been assigned should do so at the very earliest moment.

It is hardly necessary to state that exhibitors at these important conventions have the opportunity of placing their wares before the Government and railway officials and the representative [illegible] the railways of America. These men are quick to apprehend the important significance of new or improved devices. At a time like the present where there is every prospect of improved conditions in railroad matters, and also a great and growing need for new material, those engaged in the railroad supply business and miss the opportunities that these conventions afford do themselves a lasting injury. The most successful in all departments referred to continue exhibiting year after year. They know its value, and they also know that their absence would redound to their disadvantage.

Membership in the Association this [illegible] well as the highest. All members are entitled to equal privileges, and all that is necessary is to send in the name of the accredited delegate and the address of the main office. Early application [illegible] ready reference to perfect details, and the presence of a well informed representative of an active firm is not only a sign of prosperity, but a step in the direction of further success.

The officers of the association for the [illegible] National Electric Headlight Company, President; Mr. Oscar F. Ostby, Commercial Acetylene Railway Light and [illegible] Mr. J. D. Conway, Secretary-Treasurer, [illegible] 2136 Oliver Building, Pittsburgh, Pa.

Air Brake Convention.

[illegible] of the Air Brake Association will be held in the convention hall of the Hotel Sherman, Chicago, Ill., beginning on Tuesday, May 4, 1915, at 9:30 a. m., and will continue its sessions through four days, ending Friday, May 7. Members desirous of securing accommodation in the hotel are urged to make reservations as early as possible by writing to Mr. Frank W. Bering, manager. This will help to avoid delay, and the reservations can be cancelled if the member cannot attend.

The following is the list of subjects selected and the committees appointed to report thereon at the convention:

Accumulation of Moisture and Its Elimination from Trains and Yard Testing Plants.—Mark Purcell and M. F. Gannon.

[illegible] senger Equipment Cars.—J. P. Kelly, C. W. Martin, L. P. Streeter and E. J. Barry.

Need of Efficient Cleaning and Repairing of Freight Brakes.—Mark Purcell, J. T. Slattery and F. Von Bergen.

What Shall We Do to Improve the Present Pneumatic Signal Device?—L. N. Armstrong and H. L. Sandhas.

Difficulties the Railroad Companies Encounter in Endeavoring to Run 100 Per Cent. Operative Brakes in Freight Train Service.—G. H. Wood and S. C. Wheeler.

Master Car Builders' Air Brake Hose Specification.—C. D. Young.

Recommended Practice.—S. C. Down, H. A. Wahlert, G. R. Parker, J. R. Alex- [illegible]

On the afternoon of Thursday, May 6, a series of air brake lectures will be delivered by representatives of the Pittsburgh Air Brake Company, Westinghouse [illegible] Brake Company, and possibly the Automatic Straight Air System, the time of each lecturer being limited to one hour. One afternoon will also be devoted to the manufacturers' representatives for exploitation of their devices. This will occur on Tuesday, May 4. Particulars in regard to transportation may be had [illegible] street, Boston, Mass.

Railway Materials Association.

The annual convention of the Railway Materials Association, in conjunction with the Railway Storekeepers' Associa- [illegible] associations the Storekeepers' Association is preparing to feature the subject of "Reclamation of Material," and will exhibit slides showing pictures of reclamation machinery, reclamation plants and reclaim material. Any manufacturer or supply house having slides relating to this subject are invited to forward the same to Mr. D. C. Curtis, inspector of stores, Chicago, Burlington and Quincy railroad, Chicago, Ill. Mr. J. Parker Gowing, 320 West 26th St., Chicago, is Secretary-Treasurer.

International Railway Fuel Association.

The annual meeting of the Railway Fuel Association will be held at the Hotel La Salle, Chicago, Ill., beginning at 9:30 a. m., on May 17, 1915, and continue each day during the 18th, 19th, and 20th. Details in regard to particulars relating to hotel accommodation may be had on application to Mr. C. G. Hall, Chicago & Eastern Illinois Railroad, 922 McCormick Building, Chicago. The subjects that will be reported upon at the meeting are as follows: Mining and Preparation of Coal; Influence of the Operating Officials of Railways on Fuel Economy; The Locomotive, Including Practices in Relation to the Handling of Locomotives; Fire [illegible]

Master Boiler Makers' Association.

The annual convention of the Master Boiler Makers' Association will be held in Chicago, Ill., beginning on Tuesday morning, May 25, 1915, and continuing during May 26, 27 and 28. Mr. Harry D. Vought, secretary, 95 Liberty street, New York, has issued a special announcement to the officers and members in regard to the subjects to be brought before the committee, and copies may be had on application. The proceedings promise to be more than usually interesting.

Difficulties of Exact Measurements.

A well-known superintendent of motive power who uses driving wheel centers 62 inches diameter once made this statement: "It would not do for all of us to go to work and make gauges of 62 inches, and bore out the wheels by them, or turn our wheel centers by them, for no two men can take the same rule or measuring machine and measure 62 inches and get the measurements alike. The two men will vary enough to make it fatal to the practice of uniformity. Unless we secure absolute uniformity we cannot get our tire manufacturers to bore tires that will be absolutely uniform."

"I always thought," said Old Jerry as he sniffed at the particularly bad odor of a salesman's cigar, "that nothin' was as rank as the stuff some roads use on the front ends of their locomotives.

"It used to gag some of the boys," continued Jerry, "the first day it was put on and, believe me, those days came thick and fast. The blamed stuff burnt off almost as soon as it was put on.

"No, I never had any trouble on Old 689. I always used a Dixon Graphite preparation—some of the boys likes a natural gray and some a black finish and some likes a powder and others a paste—Dixon makes 'em all. Sweet and clean and always lasted from six to nine weeks.

"Sure you can get a testin' sample. Write as I did and ask for folder and free sample No. 69."

Joseph Dixon Crucible Company

Established 1827

JERSEY CITY, N. J. 2-F

RAILROAD NOTES.

The Maine Central is reported in the market for [illegible].

The Boston & Maine is reported in the market for 3,000 [illegible].

The Vandalia is in the market for 25 consolidation engines, it is said.

The Boston & Maine has ordered 11,000 tons of rails from the Lackawanna Steel Company.

The Grand Rapids & Indiana has ordered six coaches from the Pressed Steel Car Company.

The Chesapeake & Ohio is in the market for 20 Mallet locomotives, according to a report.

The Chicago & Milwaukee Electric has ordered 15 steel passenger cars from the J. G. Brill Company.

The Montreal Locomotive Works are building four locomotives for the Greater Winnipeg Water District.

The New York, Philadelphia & Norfolk has ordered 70 box cars from the American Car & Foundry Company.

The Bethlehem Steel Company has ordered a switching locomotive from the American Locomotive Company.

The Chicago, Milwaukee & St. Paul has ordered nine 260-ton electric locomotives from the General Electric Company.

The Delaware, Lackawanna & Western has ordered five Pacific type locomotives from the American Locomotive Company.

The Ogden, Logan & Idaho has ordered a 50-ton electric locomotive from the Westinghouse Electric & Manufacturing Company.

The Missouri, Kansas & Texas has ordered 30 Mikados and 10 [illegible] locomotives from the American Locomotive Company.

The Atchison, Topeka & Santa Fe has ordered 500 60,000-pound capacity refrigerator cars from the American Car & Foundry Company.

The Chicago, Burlington & Quincy has placed an order for 2,650 center sills for the Colorado & Southern with the American Car & Foundry Company.

The Great Northern recently ordered 10,000 tons of rails, divided among the Lackawanna, Bethlehem, Cambria and the Illinois Steel Companies.

The Central of [illegible]

[illegible] combination baggage and mail cars, 10 combination passenger and baggage cars, and 15 coaches.

The Chicago, Burlington & Quincy has ordered 15 Pacific type, 20 Mikado type and 15 Santa Fe type locomotives from the Baldwin Locomotive Works.

The California Western Railroad & [illegible] saddle tank switching locomotive from the Baldwin Locomotive Company.

The Pennsylvania has placed an order with its Altoona, Pa., shops for 100 steel flat cars, 40 feet long and equipped with drop sides. Construction is to begin by May 1.

The Cleveland, Cincinnati, Chicago & St. Louis has increased its order for switching locomotives, recently placed with the American Locomotive Company, to thirteen.

The Remington Arms-Union Metallic Cartridge Company, New York, has ordered a four-wheel saddle tank switching locomotive from the American Locomotive Company.

The Philadelphia & Reading has ordered 25 steel coaches. Of this total, 15 will be furnished by the Pullman Company and 10 by the Harlan & Hollingsworth Corporation.

The Baltimore & Ohio has placed orders for 200 car bodies each with the American Car & Foundry Company, the Ralston Steel Car Company, and the Standard Steel Car Company.

The Cleveland Railway Company has bought 1,500 tons of standard steel rails, giving 500 tons to Lackawanna Steel Company and 1,000 tons to the Lorain Steel Company.

The Northern Pacific has ordered 20,000 tons of rails, divided as follows: Illinois Steel Company, 8,500 tons; Lackawanna Steel Company, 7,500 tons, and the Colorado Fuel & Iron Company, 4,000

The Baltimore & Ohio is said to have awarded contracts for rail as follows: Carnegie Steel Company, 7,000 tons; Illinois Steel Company, 5,000 tons; Pennsylvania Steel Company, 4,000 tons, and Cambria Steel Company, 9,000 tons.

The Chicago & North Western plans the erection of a roundhouse and machine shop at Eagle Grove, Iowa, to cost about $90,000, according to report. This road also contemplates an expenditure of about $100,000 for 13-stall addition to its roundhouse and construction of a modern machine shop at Boone, Ia.

Training Apprentices.

[illegible] apprentice [illegible] the [illegible] small shop, but in a large department it usually means failure for the apprentice scheme. Many foremen have said that "apprentices are a nuisance" when this method is tried. [illegible] personal attention to the boys, and the actual in- [illegible] else. We have yet to find a foreman whose attitude toward apprenticeship has not radically improved when an instructor has been placed over the apprentices. The common complaint of having "too many" has, not infrequently, changed to a request for "more."

Where apprentice instruction is left to "the man on the next machine," the things taught are far from uniform and often wrong in their principle. Only by a supervising instructor can this teaching be standardized and brought up to date. The present importance of "safety first" makes doubly necessary the training of the apprentice from the very start in the habits of caution and carefulness. This can be done without any sacrifice of output if the proper attention is given to the learner.

If the apprentice is to be developed to the highest extent he must have more than casual attention. Our agriculturists [illegible] how to make most productive the soil from which their produce must come, but the manufacturer has been very slow to realize that the human element of industry needs cultivation to bring about its highest productive ability.

Not only has the well-planned apprentice course given better training to the boys learning the trades, but it has attracted to the trades boys of higher intelligence. Many bright boys leave industrial shops because they see no opportunity for advancement, no provision for their getting proper instruction and change. While it is true that most men specialize after learning their trades, it is unquestionably true that their broader training has made them better mechanics in the special line which they have chosen.

Early Machine Tools.

In the development of mechanical industries connected with railroads, New England machine shops were better provided with tools than the machine shops of any other section of the country, yet [illegible] were turned on a lathe that had a wooden bed. The driving wheel tires were bored on another lathe of similar construction, being fastened to the face plate by means of wooden chucks with straps and bolts. New England still claims to keep well ahead in the smaller kind of machine shop tools.

Mumford Molding Machines.

It will be gratifying to the [illegible] friends of Mr. [illegible] Mumford to learn that the company bearing his name has again re-established its business and is proceeding with the manufacture of all the designs of the well-known Mumford molding machines at Front and Franklin streets, Elizabeth, N. J. All the patents and applications for patents under which the company was operating for the last five or six years, are now entirely freed from litigation, and machines so built can only be had from the [illegible] Mumford Company. The new machines being made by the company embody many new points of merit, the result of Mr. Mumford's long experience in machine construction, and we are confident that a new career of usefulness and well deserved success is now opened to the enterprising firm. The company's offices are located at 30 Church street, New York.

Engine and Locomotive.

The Latin word *ingenium*, which signifies heart, mind, abilities or genius was originally applied to any mechanical device or contrivance of an ingenius or complicated character. In the course of time the word became anglicized into engine, and those who made or operated mechanical appliances were called engineers. It is not easy to understand how the class now called civil engineers came to appropriate the name, unless it was recognized that they were performing ingenious labors.

Numerous appliances that would hardly be called engines have got their names from a corruption or abbreviation of the word engine, as "gin," "jenny," etc., but of late years the name has been applied almost exclusively to prime movers. "Locomotive," which is now used to a great extent in place of "locomotive engine," was first used by George Stephenson, who named one of his first engines "locomotive." The word was conversant and expressive, so it soon came into popular use. The Norris Locomotive Works of Philadelphia when first started, announced that they intended building "lo[illegible]

[illegible] train?"

"When the waiters and porters finished plucking me, felt sure it was." *Buman* [illegible]

[illegible]

Take things as they are and proceed to remake them according to your own ideal.

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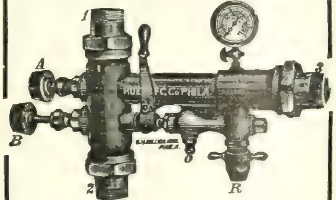

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Catalog on Injectors B 5

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Books, Bulletins, Catalogues, Etc.

The Valve-Setter's Guide.

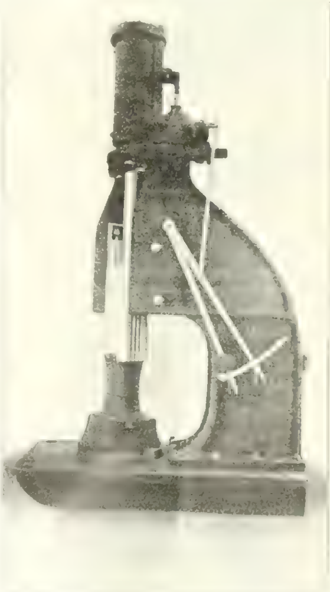
A new and revised edition of this popular book is just issued by the Angus Sinclair Company, 114 Liberty street, New York. In addition to the matter previously published in regard to link motions and valve gears generally, including details regarding the Stephenson and Walschaerts valve gearing new chapters have been written descriptive of the Baker valve gear and the Southern Locomotive valve gear, so that the book may be said to be abreast of the present hour in relation to the most popular forms of locomotive valve gears. Mr. Kennedy's long experience as an instructor of apprentices in locomotive construction and repairs eminently qualified him for such a work and while it may be justly said that the subjects have been treated before, and are being treated now by others in an able way, they have never been treated in the same way, and the same amount of popular favor has never been accorded to a work on the same subject. The present edition completes the tenth thousand called for in a few years. The style is engaging and luminous with intelligence. The presswork and illustrations are excellent. The new edition is marked with many improvements. The price remains the same —fifty cents per copy

Oxy-Acetylene Welding and Cutting.

A book of 190 pages on the above subject, including the operation and care of acetylene generating plants, and the oxygen process for the removal of carbon, by C. F. Levingle, M. E., has been published by F. J. Drake & Company, Chicago. A brief description of all principal kinds of welding is given, including fire welding, welding by water gas, thermit welding, brazing and blowpipe welding. The advantages and disadvantages of each are ably discussed, and the accomplished author shows a thorough familiarity with the details of the various processes. While the book is severely practical, enough of the theory has been included to enable the practical man to acquire a thorough understanding of the subject. The book is fully illustrated, and sells at $1 in cloth, and $1.50 in leather binding.

Steam Hammers.

The Chambersburg Engineering Company, Chambersburg, Pa., has issued a new catalogue, No. 66, describing and illustrating the latest designs in single and double frame steam hammers, steam drop hammers, board drop hammers, hydraulic forging and flanging presses, riveters, cranes and other appliances. The catalogue extends to 64 pages, with 50 illustrations, with copious descriptive matter and dimension tables. One of the latest additions to the company's fine products is the 3,300-pound single frame steam hammer of the guided ram type, built with steel frame, ribbed construction, bolted to cast iron baseplate. The box type of frame may also be made in steel. This design of hammer has already met with the highest indorsements and combines great strength and rigidity. As shown in the accompanying illustration, the guides are adjustable for taking up the wear of the ram. They are hung in pockets planed in the frame, the weight of the guide being carried by a lug solid in the guide which fits in a corresponding



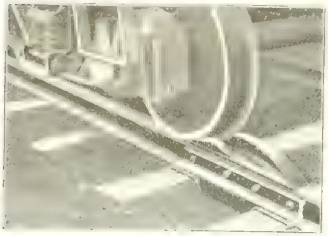
[illegible] CHAMB[illegible] [illegible]AME STEAM HAMMER.

recess in the guide pocket, thus taking their weight from the bolts which lock the adjustment and relieve the strain on the frame. The adjustment is made by a steel taper shoe which bears full width and length of guide and adjusts the guide equally top and bottom, preventing the ram from cocking in the guides. This form of guides have been adopted after many years' experience with other arrangements.

For more particular details in regard to the various designs of steam or compressed air hammers, and the company's other products, all interested should send for a copy of the catalogue, to the company's main office, Chambersburg, Pa.

Q & C Derails

The [illegible] West street, New York, has just issued a finely illustrated catalogue showing the complete designs of the company's simple and efficient derails. In point of simplicity and economy the device has the double merit of being readily applicable assuring posi- [illegible] to any rail joint by substituting two-eye bolts for two-track bolts, its application being [illegible]



[illegible] Q & C DERAIL

It does not in any way weaken the track as did the old switch point rail, and is not affected by creeping rail, being fastened to the ties only, and will derail the heaviest car or locomotive. The device meets a growing need for substantial equipment to cope with modern conditions. It can be readily placed at any point on the track, and interlocking connections can be made. Complete details will be furnished on application to the company's New York office.

Locomotive Engineer's Pocket Book.

The Locomotive Publishing Company, 3 Amen Corner, E. C., London, England, has issued the 1915 edition of the Locomotive Engineer's Pocket [illegible] containing over 300 pages, bound in flexible covers, and sold at 70 cents. Like the previous editions of this very useful book, it contains much information of daily use to locomotive engineers and others, together with a neat diary, yet the whole is not by any means of an inconvenient size for the pocket. The information covers a wide range of subjects, some of the more important of which are the follow- [illegible] tion metric measures with British equivalents, approximate weights of metals, timbers, etc., expansion and melting points of metals, specific gravi- [illegible]

Public Utility Economics.

A series of ten lectures delivered before the West Side Young Men's Christian Association, New York, embracing such subjects as Holding Companies, Public Ownership, Lighting, Future Power Supply, Telephones, are collected in a handsome volume of over 200 pages. Among the most interesting is an able discourse on the Future Regulation of Public Utilities by Mr. William D. Kerr. On the subject of the Full Crew Law Mr. Kerr's views are clear and cogent. He holds that this kind of legislation is clearly pernicious, because it is not based on an analysis of facts. It may be desirable that a particular train have a larger crew than it has, because there are some peculiarities to this train, but there are trains which do not have the peculiarities of the other. For the Legislature to say that all trains shall have a crew of a certain fixed, definite size, is not productive of general good, and is not conductive to the convenience, comfort and welfare of the public.

Boiler Makers' Tools.

"Faessler Boiler Makers' Tools" is the name of a new catalog just issued by the J. Faessler Mfg. Co., Moberly, Mo., specialists in boiler tool manufacture. This catalog fully illustrates and describes many types and sizes of boiler tube and superheater flue expanders—sectional and roller—for hand or power operation. It also shows Faessler's flue cutting tools and machines, countersinking tools, etc.

Love's Pleadings.

O, come, my love, the jitney
Waits; the nickel's in
My purse. My sparker snaps at all the
Fates, for better or
For worse. Let's jit in joy while life
Is June; five coppers pays
The bill. So come and jitney 'neath
The moon, along the low-grade
Hill While all the world is smooth
[illegible]
Spry, there's bliss in every quart
Of gas; let's hit life on
The high. So come and be my jitney
Queen; a nick is all my
Hoard. Who cares for grief or
Gasoline? Come mount
My trusty Ford

April.

And in my breast
Spring wakens, too; and my regret
Becomes an April violet
[illegible]

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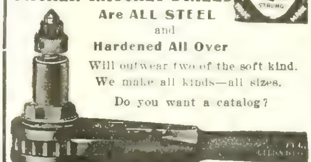

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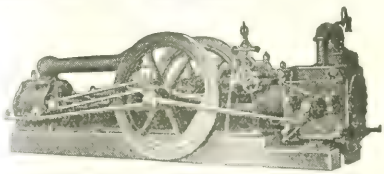

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For All Purposes
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Railway and Locomotive Engineering

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Vol. XXVIII. | 114 Liberty Street, New York, May, 1915. | No. 5

Famous Double Spiral Tunnels on the St. Gotthard Railway in the Alps in Switzerland

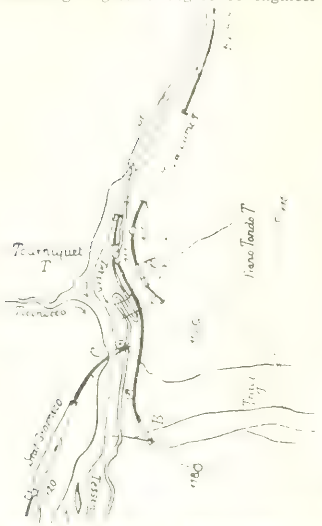
While all eyes are turned to the terrific European conflict and its amazing proportions it can be seen at a glance that the railways are the arterial life of the titanic struggle. Without them such vast armies could neither be mobilized nor sustained, and their movements from frontier to frontier could not be undertaken without the network of railways. The achievements of Hannibal, Charlemagne and Napoleon leading triumphant armies across mountains after months of weary toil, can now be accomplished in a few hours. This brings into mind the Alpine railways which are in many respects among the most remarkable in the world, for while the extent of American railways and the multiplex engineering difficulties that have been overcome are much more numerous than all of the European railways put together, it will be remembered that the Alpine tunnels and other construction work are the most extensive of their kind in existence.

Among these the Simplon tunnel through the Alps extends to 12 miles, and was opened in 1905. The St. Gotthard tunnels through the Alps connecting Goschenen with Airolo in Switzerland, is 9⅓ [illegible] 1881. The Mont Cenis tunnel between Italy and France under the Cole de [illegible] was opened in 1871. Latterly in 1913 the Loetschberg tunnel through the Alps in Oberland, Switzerland, was opened, and extends to

SPIRALS ON THE ST. GOTTHARD RAILWAY IN THE [illegible]

$9\frac{1}{4}$ miles. Others are also nearly completed, although not so extensive, in the same region.

Of equal interest and in many cases involving a greater degree of engineer-



[illegible] TUNNELS [illegible] RAILWAY

[illegible] of the various railroads through the Alpine region. One of these remarkable feats of construction is shown in our frontispiece illustration, and known as the famous spiral of the St. Gothard railway, and shows three different elevations of the same track and all within a limited space. The railway as it winds through what is known as the Reuss valley, climbs ever upwards to Goschenen, at the north portal. A tunnel opens into the mountain side, and describes almost an entire circle, approximately 1,050 feet in diameter. When it emerges from the mountain it is over the first portal, and then runs back for some distance. In less than half a mile the line enters a second peak, where it describes another loop forming the Wattinger tunnel, issuing from which it has reached a higher level. Thus, side by side, there are three tracks on three different levels, two running south and one running north, the railway traversing [illegible] half a mile in distance. Other equally amazing works occur along the Alpine [illegible] these are surpassed in number and variety on the American continent they are not equaled in single instances either in the length of tunneling or in the ingenuity in overcoming the great natural difficulties encountered.

The second illustration shows a view of the plan of the double spiral tunnels on the St. Gotthard railway, and is a unique work of its kind.

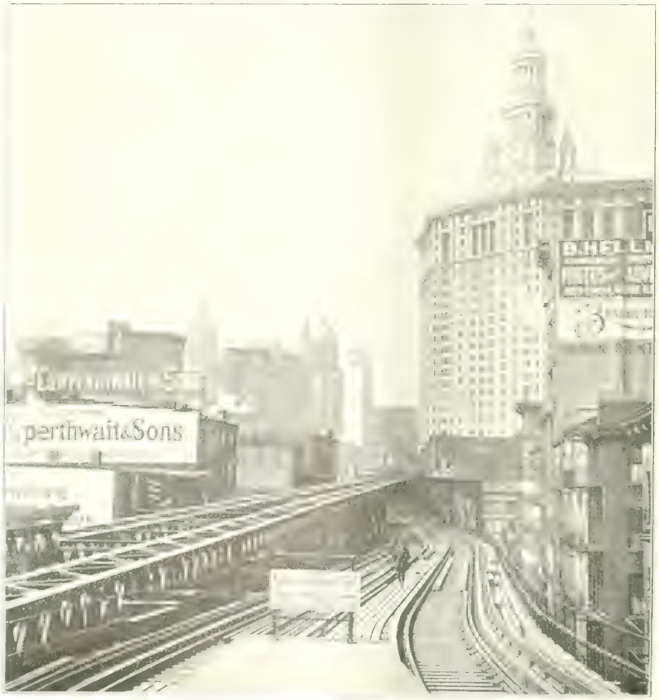
Extensive Improvements on the Interborough Rapid Transit Lines in Manhattan, New York

Improvements and additions to the elevated tracks of the Interborough Rapid Transit lines in the Manhattan division of New York involving an expenditure of thirty million dollars, and which will be completed in the period of two years as originally specified are progressing so quietly and so rapidly, and without the slightest interruption in the present local or express traffic that the people are almost unconscious of the gigantic work that is going on, and adding an improvement in rapid transit that bids fair to outrival the subway in the rapidity of transit, and particularly in the degree of comfort with which the forty miles of roadway may be traversed.

The express trains [illegible] called at present, are only partially express in the distance run. Taking the City Hall station on the Third avenue elevated railroad as an illustration, both the local and express trains are on the same tracks and continue on the same track until Forty-second street is reached, stopping at least ten times at the local stations reaching that point, so that the distance run by express does not exceed three miles, a little more than one-fifth of the entire line. Of course some time is saved in a section of the journey, but the total saving is not great.

In the new scheme of improvement the express trains will run almost the entire journey on their own tracks. As shown in the illustration a story or upper structure is added in certain portions of the road and the express traffic is accommodated with platforms separate and above those of the local traffic. In that portion where express tracks are already in operation extra raised stations are being constructed, which placed considerably further apart than the local stations are, may be said to extend the express traffic, and its time saving benefits, to the entire city, as the express stations are being established in the most populous districts, as is the case with the subway express stations.

The entire scheme of improvement marks an important advance in the rapid



[illegible] INTERBOROUGH RAPID TRANSIT LINES

intervening. After reaching Forty-second street, a continuous journey is then made until the Harlem district is reached, and stops are made at each local station after transit work that has been goin. on, and in point of saving of time and comfort in traveling will mark a new era in city passenger traffic.

Alaska Railway.

The United States Government has signified its approval of the Susitna route for the proposed railway to be constructed in Alaska. The Alaska Northern already running from Seward, a distance of 71 miles, will be a part of the new line, and will be extended in a northerly direction across Broad Pass and along the bank of the Tanana river to Fairbanks, the new portion being about 400 miles. The work is already begun, and it is expected that about 40 miles will be completed this year. The Alaskan Engineering Commission includes Mr. William C. Edes, chairman; Lieutenant Frederick Mears and Mr. Thomas Riggs, Jr. The headquarters of the chairman will be at Seward, Alaska. Those who wish to secure work on this railroad should send an application to the Alaska Engineering Commission, Bureau of Mines building, Washington, D. C. It is not necessary to pass a civil service examination to secure an appointment, but employees must pay their own transportation to Seattle, Wash., from which point transportation will be furnished to employees.

Argentine Railways.

An addition of 514 miles was added last year to the total mileage of railway track in Argentine, which now extends to 13,328 miles, not including 861 miles of track of the Bahia Blanca and North-Eastern Line, which now belongs to the Pacific system. Last year was a most unsatisfactory one for Argentine railways. Receipts were greatly reduced by the economic depression aggravated by the European war, and partial failures of the wheat and linseed crops. Furthermore, heavy rains, besides causing serious damage to lines, almost suspended movement of the heavy corn crop.

During the year a number of the leading railways informed the government that, in view of increased working expenses and the falling off in receipts, they would be compelled to raise their tariffs. This was sanctioned by the government in February. The proposed increases naturally met with opposition on the part of shippers, no less affected by business depression than the railways themselves, and after a series of conferences between the government and the railways it was decided that the rates in question would be raised 10 per cent. instead of 20 per cent., as originally planned.

Railways in Dutch East India.

In the islands of Java, Sumatra, and the Dutch East Indian archipelago there are a total of 1,42[illegible] miles on these islands, with 461 locomotives, 760 passenger cars and 7,930 freight cars in service. There are a few Mallet locomotives where the grades are heavy.

On the Java State railways 65 per cent. of the engines are of German make, 23 per cent. British and only 5 per cent. from the Netherlands; on the Sumatra line all the engines, 65, are of German make. In Java there are six repair shops, but only two of them of any considerable size; these are at Bandeong and Madioen.

Proposed Improvement in Jersey City Railroad Terminals.

A proposition is on foot to [illegible] double track main line through five miles of city streets along the water front in Jersey City, extending from the Lackawanna depot in Hoboken to Communipaw, with perhaps an extensioin to connect with the West Side connecting railroad, which it is proposed to construct along Newark bay and the Hackensack river. It is intended to connect all the trunk lines having terminals in Jersey City, and will necessarily involve the construction of numerous sidings and industry tracks. Electricity will be the motive power, and it is expected that the proposed railroad will add greatly to the number of manufacturing plants already established in that vicinity.

Extensions on the Southern Railway.

Over 100 miles of double track is now under course of construction on the Washington-Atlanta line, 66 miles of the work being in Virginia, and 36 miles in North Carolina. Between Washington and Atlanta 284.5 miles of double track are now in service, so that with the completion of the work now under construction, which is expected during the present year, Southern Railway will have a total of 386.9 miles of double track on this line, which is 649 miles in length. Two line revision projects are also under way in North Georgia, involving the construction of 6½ miles of entirely new line with greatly improved curves and grades.

Labor Statistics.

The average full-time weekly earnings in the principal occupations among 42,000 employees in 1913 were reported as follows: Cabinetmakers, $19.03; carpenter and car builders, $17.11; car repairers, $15.15; machine woodworkers, $16.20; machinists, $17.81; painters, $17.17; pipe fitters, $18.56; riveters, $19.41; truck builders, $15.31; laborers, $10.58. In 1913 the full-time hours of labor per week were under 54 in quite a number of the establishments visited, and over 60 in but very few. The predominating full-time hours per week were 54, and the average about 56.

Hudson Bay Railway.

The Hudson Bay Railway route will be 424 miles in length, and will extend from Le Pas to Port Nelson, 240 miles of which is now completely graded, and 54 miles partly graded—trains are expected to be run at an early date at least 200 miles. This year's work will probably complete grading operations to Port Nelson, and the whole line it is expected will be in complete operation by next year, and will form an important link in the Canadian railway system, giving direct and easy communication to the waters of Hudson Bay.

Arkansas Railroad Rates Raised.

An increase of railroad rates approaching 30 per cent. are in effect this month, according to a decree of the United States Court. The decision was made on the grounds that the old rates were confiscatory. The passenger rate is now 3 cents per mile. The Arkansas State Commission will appeal the case to the Supreme Court. The returns on the railroad investments on the new rating will, it is said, not exceed four per cent.

Work on the New Terminal at Buffalo Begun.

Work on the excavations for the new terminals of the Lehigh Valley at Buffalo, N. Y., was begun last month. The State legislature is expected to pass a bill authorizing the ceding of canal lands in Buffalo, so that the Terrace station plans of the New York Central can be carried out. The plans must be considerably changed unless a portion of the canal lands can be utilized.

Long Island and Rapid Transit.

The Public Service Commission of New York has been informed regarding the terms upon which the city of New York may obtain use of the Long Island tracks for extension of the city's rapid transit system. It is suggested that the agreement provide for a trackage arrangement to cover a period of ten years, with the privilege of renewal for an additional period of ten years, either party to have the right to terminate the agreement on three years' notice, the Long Island Company receiving a rental charge of $250,000 per annum.

The Miller platform, so well known in passenger car construction, was invented by Ezra Miller, long a resident of New Jersey, which he represented in the State senate at the time of his death in 1885. The purpose of the Miller platform was to prevent the telescoping of cars when collisions happened, and it has proved a valuable life saver in case of such accidents.

Notes and Comments on Locomotive Lubrication

The Lubricator and its Connections

By F. P. ROESCH
Master Mechanic, El Paso & Southwestern System

Cylinder Lubrication.

[illegible] ferences never being considered. Or, if considered, being presumably too mys[illegible]. Therefore, before proceeding further it might be well to show how and why a hydrostatic lubricator delivers oil to the [illegible]

[illegible] sections through an ordinary Bull's Eye [illegible] the various parts and their duties are no doubt familiar to all, it is not necessary to dwell upon them. When the lubricator is filled with oil and the steam and condensing [illegible] When the condensation of water rises to the top of the middle tube a, shown in Figure 7 [illegible] passes underneath the oil, raising the oil up to [illegible] condensation of water always remains at the height of the middle tube. All further steam passing into the lubricator passes down through tubes 17, termed the equalizing tubes. A portion of this steam is also condensed, and the water or condensation rises to the choke plug, the remainder of the steam then passing out [illegible] pipe. We, therefore, have the following condition: A column of water equal to the [illegible] it, acting against the bottom of the oil, forcing the oil upward, and a column of water equal in height from the choke plug to the feed valve. This also has the same pressure of steam acting on top of it, but as there is a greater pressure on the oil due to the difference in heights of the two columns of water, when the feed valve is opened the oil is forced out through the feed nozzle, from whence, being lighter than the water, it is carried upward to the choke plug, [illegible] steam passing through the equalizing [illegible] from whence it drops by gravity to the steam chest. It can, therefore, be seen [illegible] of equal height, the pressure at the feed nozzle would be balanced, and, consequently, no oil would come from the feed [illegible]

action of the hydrostatic lubricator when these facts are remembered. There is one point in connection with the lubricator that is frequently overlooked in the round house, however, and that is that in order that the oil may be carried to the steam chest there must be a current of steam continually passing through the oil pipes. Consequently, the pressure in the oil pipes must be greater than the pressure in the steam chest, and as the only supply of steam through the oil pipes comes from the steam pipe leading to the lubricator, it is evident that this pipe must be greater in area than the combined area of the two oil pipes, and [illegible]

Referring now to Figure 8, which shows a not unusual lubricator installation, we presume that a casual glance at this illustration would indicate nothing materially wrong. Let us investigate, however. The first thing to attract attention is the steam pipe leading to the lubricator. Two defects are here found, one that the steam pipe is so straight that there is little room for vibration or expansion. Result will be a leak at one end of the pipe or the other. Again, this steam pipe is too small in comparison with the oil pipe. Next the oil pipe: notice how gracefully it is curved over the boiler head. While it looks good, yet we find a drop where it leaves the lubricator. As explained in a previous

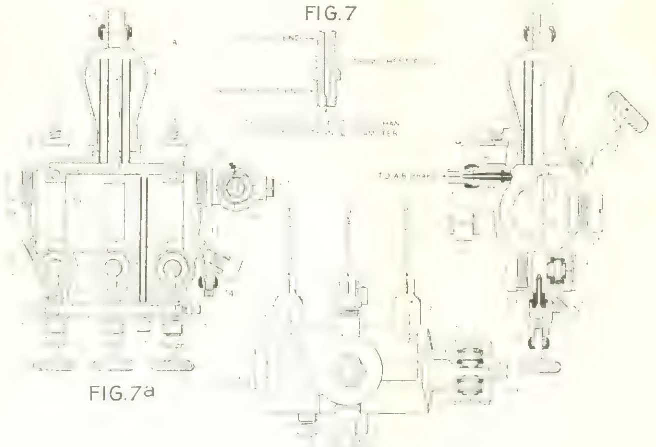


FIG. 7

FIG. 7a

boiler pressure in the two equalizing [illegible] overbalances the oil pipe pressure, circulation in the oil pipes will be arrested and the steam will condense into water at the point where the two pressures balance, and as the oil is lighter than the water it cannot pass through it, but will float on top of the water until the throttle is partially or wholly closed, so that the lubricator pressure overcomes the steam chest pressure. It is on account of this balance of pressures that valves will begin to go dry when the engine has [illegible] a full throttle, and that a partial closing of the throttle will immediately relieve [illegible]

paragraph, the oil must feed from the lubricator [illegible] by gravity and as the action of gravity never yet caused oil to run up hill, it is plain that the oil will continue to lodge in this trap until the pipe is full of oil, and it is forced out by the pressure of the steam behind it. The result is that the valves will get oil by fits and starts. In other words the feed will not be constant to the valve, although it may be constant and regular at the lubricator as shown through the sight feed glasses. Therefore, in this instance, either the oil pipe should be [illegible] across the back of the boiler head or else the lubricator should be raised so as to afford a constant fall to the pipe from the

lubricator along to the steam chest.

Another defect that might perhaps pass unnoticed is the location of the end of the drain pipe. This, as will be noticed, discharges into the gauge cock dripper. This defect, although apparently slight, has, however, quite an influence on lubrication costs, as, for instance, in draining the lubricator you cannot see, especially at night, when all the water has been drained off and the oil begins to flow, with the result that considerable valve oil is thus wasted. Not only that, but the oil falling into the gauge cock dripper will have a gradual tendency to close the drip pipe, with the result that the dripper will become filled with water, giving an inaccurate gauge cock registration. Before closing on lubricator location we would call attention to the manner in which lubricators are frequently mounted on boiler heads, namely, with a dark background behind them, so that it is practically impossible for an engineer to tell how fast his lubricator is feeding unless he uses a torch. It would be just as easy to locate lubricators facing windows or other cab openings, so as to make the use of the torch unnecessary except at night.

There is another item in connection with Figure 8 to which it might be well to call attention, namely, the hand oilers. We presume that at a casual glance nothing would be noticed as seriously wrong with these. The trouble with these hand oilers is that they are too large, as the human equation must always be taken into consideration even in building hand oilers. With the modern grease lubricated locomotive it should never be necessary to use more than one pint of engine oil to completely lubricate the average engine. The average hand oiler, however, contains from two to three pints of oil, and as the tendency of the engineer is to continue oiling as long as he has oil in his can, if the hand oilers were reduced in capacity to just sufficient to oil a locomotive once, he would undoubtedly be more careful. As he would feel his can getting light and thereby oil around with one pint or less, where if he had a larger can he would use more than one pint. Of course, objections would be raised to the small hand oiler, due to the fact that they would require more frequent filling. This in itself, however, would result in economy, as no one is looking for extra work, and, consequently, the oil cans would not be filled any more than absolutely necessary.

DRIFTING.

With the advent of piston valves more trouble has been experienced in valve and cylinder lubrication while drifting than when the plain "D" or slide valve was in use. The principal reason for this is due to the elimination of the relief or suction valve, and to the manner in which the oil pipe plug may be located.

Referring to Figure 9, which shows a cross section through a cylinder saddle, valve chamber and cylinder; the oil plug in this instance is shown as tapped direct into the steam channel. While this is an ideal location when working steam, yet unless a relief valve is used there will be little or no oil passing to the valve or cylinder with the throttle closed. As can be seen by referring to the figure, the steam channel forms a pocket, and

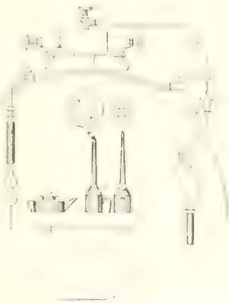
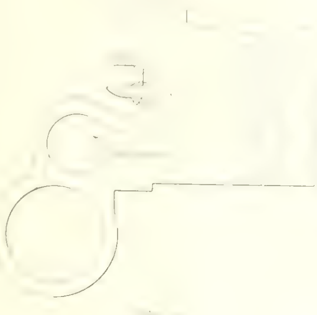


FIG. 8.

when the engine is drifting so that there is no circulation through the steam channel, the oil fed from the lubricator will naturally drop into this pocket and remain there until the condensed steam passing through the oil pipe rises to a point where it can flow into the steam chest, and thus carry the oil which is floating on top of this condensed steam in with it. If, however, a relief valve is inserted into the steam channel either



above or below the oil plug, the current of air passing in through the relief valve will carry the drop of oil in with it, and thus lubricate the valve and cylinder just the same as though working steam.

[illegible]

Engineers [illegible] close the lubricator feeds when the engine is at rest or while standing in side tracks waiting for other trains, figuring no doubt, that the oil goes into the steam chest anyhow, and will serve its purpose when the engine is again started. While this may have been the case when slide valves were used, yet with the modern piston valve of the inside admission type, the greater portion of the oil fed while standing is practically wasted. Referring to Figure 10, the upper figure shows a section through the ordinary steam chest and "D" type of balanced slide valve. In this case the oil passing through the oil pipe drops on top of the pressure plate, from where it gradually falls down, dropping into the steam supply ports. This oil is not altogether wasted, as when the throttle is opened the steam rushing up through the supply ports carries the oil with it, depositing it on the valve seat and within the cylinder. The only waste in this connection is that more oil is carried into the cylinder and distributed on the valve seat than is necessary at that time.

Referring to the lower figure, however, which shows a section through an inside admission piston valve; in this case the oil lodges in the cavity between the valve chamber bushings, and will remain there even after the throttle is opened. In fact it is only carried out when there is sufficient condensation in the steam channel to raise the oil to the level of the bushing; and in this instance the oil, being carried into the cylinders with water, it is absolutely wasted, as it is usually discharged either through the cylinder cocks or through the stack. Before leaving this figure we would call attention to the oil or tallow pipe connected with the upper steam chest, a condition very frequently found. The bend in the oil pipe, as in the case cited when referring to the lubricator, forming a trap which will hold up the oil until the trap has become filled, thereby producing an intermittent feed.

[illegible]

Before closing this article a few words in regard to the lubrication of superheated steam locomotives may not come amiss. When superheated steam was first introduced it was the general opinion that a considerable increase in valve oil would be necessary, and also that a different quality of valve oil must be furnished. While a slight increase in valve oil is necessary, the only increase, however, is due to the increase in cylinder dimensions. That is the supply of oil should be increased in proportion to the area to be lubricated. So far as the quality of the valve oil is concerned, the valve oil furnished by the Galena Company, and known as "Perfection" valve oil, will answer every requirement. While it is true that the flash point of Perfection valve oil is lower than the temperature obtained with superheated steam, yet this does not prevent the oil from fulfilling its functions.

In the first place the lubricating qualities of any oil can only be destroyed in two ways: first, by combustion, and second, by compression. As Perfection oil can readily withstand any pressure put upon it in a locomotive valve or cylinder, the latter item can be disregarded. Consequently, it is only necessary to take the matter of combustion into consideration.

Combustion of any combustible can only take place in the presence of oxygen, as it is necessary for the oxygen to combine with matter in order to produce combustion. In locomotive cylinders while working steam oxygen is present, but it is combined with hydrogen, and consequently cannot under any circumstances produce combustion regardless of the temperature. Therefore, the oil fed into the cylinder is simply vaporized and thoroughly intermingled with the steam. As any oil can be converted into vapor when raised to a certain temperature, it can likewise be liquified again or converted back into oil, when the temperature is again reduced below the point of vaporization. In a locomotive cylinder using steam the temperature varies with the travel of the piston, that is, at the beginning of the stroke the steam is at its highest pressure and highest temperature. After the steam has been cut off by the action of the valve it expands with the movement of the piston, and in expanding its pressure and temperature are likewise reduced. And while the temperature at the beginning of the stroke may have been above the vaporizing point of the oil, yet at the termination of the [illegible] point of the oil. Consequently, while the oil is [illegible] comes liquified again before the stroke is completed, the liquefaction taking place at the coolest points, which are naturally the cylinder walls, and consequently the oil is deposited exactly where wanted.

There is only one condition under which improper lubrication, due to the combustion of the oil, can take place on locomotives using superheated steam, and

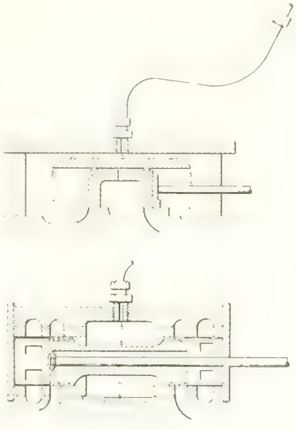


FIG. 10.

that is at the instant that the throttle is closed. As previously stated, the temperature of superheated steam is frequently above that of the flash point of the oil. Consequently, when working steam right along the valves and cylinders become heated to the temperature of the steam, and all the oil that has been [illegible] the cylinders is present in the form of a [illegible] flash under proper conditions. These conditions, as previously stated, are the admission of free oxygen; consequently, if with the cylinders heated above the flash point of the oil the throttle is suddenly closed; air, which contains the oxygen, is admitted to the cylinders—the oxygen, combining with the oil, producing combustion—in other words, burning or carbonizing the oil. To overcome this feature many roads have adopted the use of the drifting valve, which is a valve that continues to admit steam to the valves and cylinders when the throttle is closed, thereby keeping a sufficient quantity of steam in the cylinders to prevent the combustion of the oil. The drifting valve is not an absolute necessity, however, as the combustion of the oil can readily be overcome by a little care on the part of the engineer; as in stopping, if the throttle is left partly open so as to admit just a little steam into the cylinders, and left open until the cylinders have cooled down below the flash point of the oil, which only requires a few moments, the combustion of the oil will not take place. Or when topping a hill, if the throttle be kept cracked for a few miles until the temperature of the cylinders has been reduced, all trouble from carbonizing or combustion of oil will be entirely eliminated.

In conclusion, Mr. W. V. Turner once said when speaking of handling long trains that "the engineer is often blamed for rough handling, when he of all men is least responsible." So likewise is the engineer frequently censured for hot bearings and cut cylinders, when he of all men connected with the care and operation of the locomotive is least to blame.

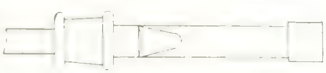
Improved Signal Whistle

By J. H. HAHN, Air Brake Mechanic
Atlantic Coast Line Railroad, Savannah, Ga

[illegible] and in order that signals may be transmitted correctly to the engineman the equipment must be in proper working [illegible] loud, clear tone. The ordinary factory [illegible] more readily put out of commission by vibration and small particles of rust and scale from the main reservoir and pipes than the home made whistle illustrated.

This whistle, which is about as near "trouble proof" as a signal whistle can be made, is made of a pipe nipple [illegible] lengthening or shortening the nipple any desired tone can be obtained.

Some of the other causes of an erratic working signal whistle are a sluggish reducing valve, a reducing valve that is [illegible]



[illegible]

signal strainer and check valve, or a bad seat on the check valve 4, which will cause the whistle to blow whenever an independent application of the brakes is made. A baggy or leaky diaphragm 12 in the signal whistle valve. Obstructed ports and leaks in the signal line. Choke fittings with improper size openings. Signal valve stem 10 fitting too loose or too tight in bushing 9.

Never use oil of any kind on any part of the signal equipment. Lubricate the parts of the signal reducing valve with a very fine grade of air brake graphite which is made for such purposes, and if it is necessary to lubricate the stem 10 in the signal whistle valve, apply a thin coating of graphite.

Test the signal equipment at regular intervals, and note action of reducing valve in opening and closing, the blasts of the whistle and amount of pressure carried in signal line. Examine all pipe connections and valves for leaks, and at once correct any defects that may exist.

Improved Locomotive Exhaust Nozzle

Data Showing Increased Power in Draft

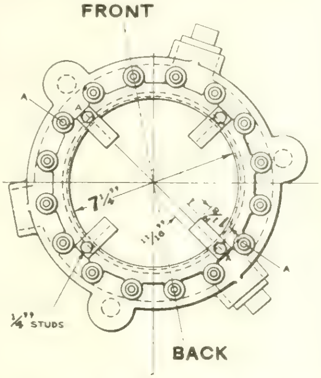
By F. A. GOODFELLOW
Foreman Locomotive Testing Plant, Pennsylvania Railroad Altoona, Pa

A new design of locomotive exhaust nozzle has been developed on the locomotive testing plant at Altoona, Pa., and the results as shown in the appended tables are of the most assuring kind that the device is really a marked improvement in the matter of sustaining and increasing the draft. The new nozzle, as shown in the accompanying illustrations, has a circular opening with four triangular projections, each of which extends out 1⅛ inches from the periphery of the opening, and is 11/16 of an inch in width at its top face. The four projections diminish the area of the opening 3.44 sq. in. in the nozzle shown in the drawing. The steel projections are machined to size and fastened in place by studs, so that the apex of each piece points in a downward direction. These projections will be drop forged in the future, thus saving the cost for machining; they will also be fastened permanently in place by electric welding, the object of which is to prevent their removal.

In making up a nozzle of this type it has been the practice to bore the circular nozzle for the particular class of locomotive on which it is to be tried ¼ of an inch larger than the specified diameter. The four projections are then made to give an area equal to the difference between specified and bored out areas. This method reduces the cost of application to a minimum, and does not necessitate the making of a new nozzle. The purpose of the projections is to break up the continuity of the nearly cylindrical jet, which is produced by the old circular form of nozzle, and change it to one similar to a Maltese cross, thereby creating a greater vacuum in the front, and to aid in the entrainment of a larger volume of the gases.

The performance obtained with the four internal projection nozzle has been equally as good, and in many instances superior to that given with other forms of nozzles designed in the past for accomplishing the same purpose. Frequently, since the adoption of this nozzle, the steaming capacity of locomotives in road service has been considerably improved by substituting it in place of another form of nozzle.

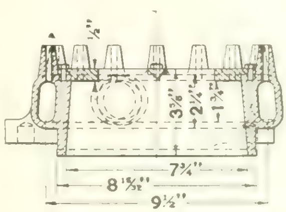
The new type of nozzle possesses a feature worthy of mention which gives it an advantage over the circular type, in that it is impossible to either increase or decrease its opening without breaking the welded projections. This, no doubt, will eliminate any tendency for an incompetent person to make unauthorized changes in the size of a standard nozzle, which has been applied to a locomotive, an occurrence which hitherto has happened. This nozzle is fastened to the column without endeavoring to place it in a particular position with reference to the location of the projections. Experiments have proven that this does not



PLAN VIEW OF IMPROVED EXHAUST NOZZLE SHOWING PROJECTIONS.

alter its performance and therefore, there is no possibility of the nozzle being incorrectly applied.

A number of tests were made in the Locomotive Testing Plant with Atlantic, Pacific and Mikado types of locomotives, using the standard circular and four internal projection nozzles.



SECTION VIEW OF IMPROVED EXHAUST NOZZLE SHOWING PROJECTIONS.

In order that the comparison between the different types of locomotives and the effect when using the improved exhaust nozzle may be completely understood, an appended table showing the general dimensions of the locomotives is given, and by carefully noting the data it will be observed that a much better performance in general was obtained from each of the locomotives when using the new type of nozzle, and especially is this true in the case of the Pacific and Mikado types of locomotives, both of which have boilers similar in design. The results as shown for the circular exhaust nozzle on the Mikado type of locomotive, were taken from a test after two efforts were made at that speed and cut-off. On the first test the average boiler pressure was 184 pounds. The Pacific type of locomotive delivered an equivalent evaporation of 87,414 pounds per hour and 3,183.9 indicated horsepower with the four internal projection nozzle, while with the standard 7-inch diameter circular nozzle, it was possible to obtain but 51,842 pounds equivalent evaporation per hour and 2,241.5 indicated horsepower.

The Mikado type locomotive, having smaller drivers and a longer stroke, developed 79,675 pounds equivalent evaporation per hour compared with 58,539 pounds obtained with the circular nozzle, and 2,835.5 indicated horsepower or an increase of 469 i. h. p. above what was developed with the use of the 7-inch circular nozzle. Comparing the performance of the Atlantic type locomotive when equipped with each of the two nozzles, there was obtained with the four internal projection nozzle, an increase in equivalent evaporation of 24.2 per cent. and 14.6 per cent. greater indicated horsepower.

During the tests, dynamic pressure observations were taken of the gases leaving the stack. The pressures were fairly uniform in each case, indicating that the stack was completely filled. The considerably higher front end draft obtained with the new type of nozzle in each instance, is responsible for the remarkable results attained, enabling a much greater rate of combustion and a higher degree of superheat to be obtained. These tests have served to demonstrate the efficiency of the new nozzle and they further indicate that a greater locomotive performance may be obtained when spreading the exhaust steam jet, from the cylinders, by the use of the internal projections.

It may be added that the improved nozzle has been covered by patent recently secured by the author, and the introduction of this interesting improvement into popular use may be confidently anticipated.

The reliability of the data furnished may be regarded as indisputable in so far as data furnished by a thoroughly equipped testing plant is of value, but arrangements are being made to make tests at an early date with locomotives in service and we expect to be able to report further on this improvement, and if the facts already on hand are borne out, a real gain in fuel economy will have been made.

Types and Dimensions of Locomotives Used in Testing Improved Exhaust Nozzle

	Atlantic	Pacific	Mikado
Total weight in working order, lbs.	240,000	309,140	315,000
Weight on drivers in working order, lbs.	133,100	202,880	235,800
Cylinders (simple), inches	23½ x 26	27 x 28	27 x 30
Diameter of driving wheels	80	80	62
Heating surface, tubes (water side) sq. ft.	2,634.50	3,728.64	3,715.71
Heating surface, firebox, including arch tubes, sq. ft.	232.74	306.77	301.51
Heating surface, superheater (fireside).	810.60	1,171.85	1,171.63
Heating surface, total (based on water side of tubes) including superheater, sq. ft.	3,677.8	5,204.40	5,188.85
Heating surface, total (based on fireside of tubes) including superheater, sq. ft.	3,405.6	4,863.96	4,847.73
Grate area, sq. ft.	55.79	69.26	70.03
Boiler pressure, lbs. per sq. in.	205	205	205
Valves, type	12 inch Piston	12 inch Piston	12 inch Piston
Valve motion, type	Walschaerts	Walschaerts	Walschaerts
Firebox, type	Wide Belpaire	Wide Belpaire	Wide Belpaire
Tubes, number	242	237	237
Tubes outside diameter, inches	2	2¼	2¼
Flues (for superheater), number	36	40	40
Flues (outside diameter), inches	5.375	5.5	5.5
Tubes, length, inches	179.71	227.23	226.51

The following table gives a comparison between the maximum results which were obtained from the locomotives when using each of the two nozzles. Aside from changing nozzles, the locomotives were subjected to no other changes during the tests which were of one hour or more in duration. A wide open throttle was used in each instance. The working pressure was 205 pounds per square inch

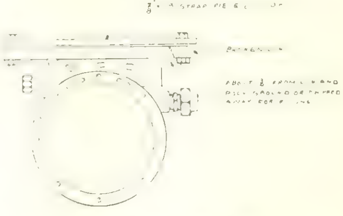
Kind of Locomotive	Atlantic		Pacific		Mikado	
Kind of Nozzle	Four Internal Projections	Circular 6.25 in. Diameter	Four Internal Projections	Circular 7 in. Diameter	Four Internal Projections	Circular 7 in. Diameter
Area of nozzle, sq. in.	[illegible]	30.68	38.19	38.45	38.08	38.45
Speed, m. p. h.	46.9	47.0	47.3	37.8	28.3	29.3
Actual cut-off in per cent.	52.0	46.0	60.3	46.4	60.8	51.1
Average boiler pressure.	204.9	184.8	201.3	202.2	204.7	204.4
Draft in smokebox	15.1	8.3	18.8	5.7	14.9	8.6
Draft in ashpan	0.40	0.41	0.71	0.51	0.60	0.64
Dry coal fired per hr., lbs.	8,271	6,942	11,813	5,146	9,312	6,621
Dry coal per sq. ft. grate.	148.3	124.4	170.6	74.3	133.0	94.6
Water evap. per hr., lbs.	44,628	35,928	65,400	39,977	59,508	46,170
Equiv. evap. per hr., lbs.	58,641	46,771	87,414	51,842	79,675	58,539
Superheat, degrees, Fahr.	204.2	175.9	215.2	157.2	183.5	122.2
Indicated horsepower	2,304.8	1,901.1	3,183.9	2,241.5	2,835.5	2,366.7

Inexpensive Repair of a Common Break of the $9\frac{1}{2}$ Inch Air Brake Pump, and Grip for Lifting Front End Doors

By F. W. BENTLEY, Chicago & Northwestern Railway, Missouri Valley, Ia.

The 9½ inch air pump suffers one breakage as a common occurrence, and that is of the holding lugs or ears by which it fastens to the pump brackets on [illegible] which have been in service for some time are examined, about 30 per cent. of them will be found to have one if not more of the lugs broken off and repaired.

If the cylinder is not yet worn and consequently bored to the limit, then of course an attempt is made to repair it in order to reclaim an expensive cylinder. In the majority of cases the repair is satisfactorily accomplished by the application of a wrought iron patch shaped, fitted and riveted to that portion of the bracket boss towards the middle of the cylinder. This is a piece of work the



REPAIR ON AIR PUMP

expense of which at a low estimate will run as high as $3, or perhaps more, according to the nature of the patch made and the method deemed satisfactory to hold it securely in place.

The accompanying sketch shows how a

GRIP FOR LIFTING FRONT END DOOR

lug is applied by the welding flame at a cost estimate of not over $1. The broken lug is held in place by a strap during the operation. Ground off to allow a space for filling, the lug can be loaded or welded on by a filling, and be as strong

DETAILS OF GRIP FOR FRONT END DOOR

at that point as if held by the original metal of the body. By means of the flame the mishap can be repaired more quickly and cheaply than through the application of a patch of any nature.

In regard to front end doors it is well known that the cast iron front end door is an unwieldly arrangement to handle, not so much because of its weight, but through shape and the place it occupies on the locomotive insofar as removing and applying it is concerned. The average pilot does not safely accommodate enough men to lift it in place, and for that reason a shop where safety is observed, generally requires the doors to be lifted in place with tackle blocks, so that in case of accident workmen will not be at any time in danger of the falling door should something give way.

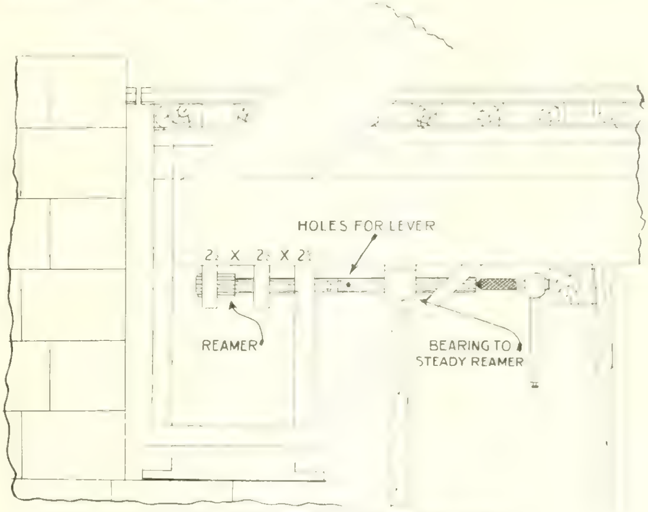
The accompanying sketch shows a simple grip jig for holding the door safely while it is being raised into place on the ring. The set screw catches the door below the putty face or raised rim by which it is impossible for it to slip. The door can be caught central and balanced perfectly as it is pulled up and placed on the lugs of the door rim.

Bridge Repairs on the Canadian Pacific Railway

By J. G. KOPPELL, Mechanical Electrical Superintendent of Bridges, Sault Ste. Marie, Ontario, Canada

In draw bridges which are in service since 1887 the end jacks and the jack pins are practically worn out and the pin seats are worn oval about one-quarter of an inch. The new pins were made one-quarter of an inch larger in diameter and a suitable reamer was secured to ream out the pin holes, to take the new pins.

The accompanying illustration shows the arrangement how the reaming was done. The reamer was fitted on mandrel of suitable link and suitable bearing from cast iron were provided, to steady the mandrel, and three holes were drilled in thirds to turn the mandrel with a bar and a ratchet was inserted on the other end to feed the reamer. The total distance per hole to be reamed was 3 x 2½ inches and four holes in all, which were done by three men in three days' time. Two men were working on the reamer and the third man was watching for trains, and when trains were in sight then he signaled and the reamers were taken out of the cut, because there was severe rattling when the train was going over the bridge which might have broken the reamer. The average number of trains per day was one train per each hour.



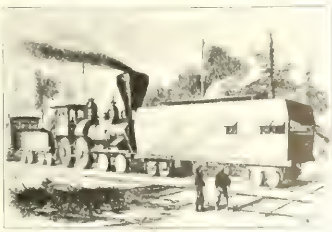
DETAILS OF METHOD OF [illegible] REAMER

The Origin of Armored Railroad Cars Unquestionably the Product of the American Civil War

By L. LODIAN, Manhattan, N. Y.

In the March issue of RAILWAY AND LOCOMOTIVE ENGINEERING an item appeared in reference to armored cars in warfare, and it was stated that they first appeared in the Anglo-Egyptian war in 1882. The fact is that the armored car was in service twenty years before the war referred to. Our own Civil war originated them. Attached is a picture of one in use on the old Philadelphia-Baltimore Railroad. The illustration appeared in Frank Leslie's illustrated periodical on May 18, 1864. No better proof could be furnished of the authenticity of the fact that such a car was in use at that time. No doubt some of the older readers may recall seeing the car. Probably, however, it may never be known what became of the armored curiosity, any more than is known of Robert Fulton's first steamer that traversed the waters of the Hudson river, except that part of the timber was said to have been used as planking [illegible] jetty-head.

There appears to be no great variation even today in armored car design from the initial effort of half a century ago. Pictures are appearing in numerous periodicals at the period of writing of those in use by the European belligerents, and in general appearance and outline they are about the same as the original. The chief variation in their use being that the war-going locomotive is also sheathed in armor, whereas that in use in the sixties was entirely unprotected except in front, and then only by reason of the mail-clad car being placed in front to do the fighting.



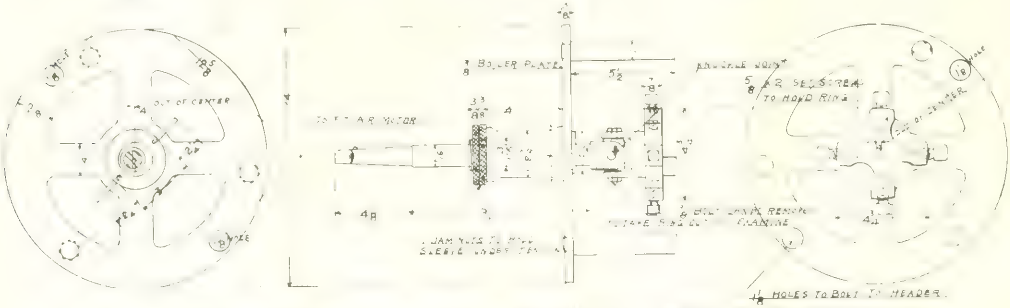
RAILROAD BATTERY ON THE [illegible]
PHILA. & BALTIMORE [illegible]
Reprint [illegible]

Thus it is established that the American Civil war produced the armored railroad car, just as it originated iron-clad war vessels. It will be remembered that the steamer "Merrimac," renamed the "Virginia," had her decks and sides covered with rails from a Southern railroad yard, and worked much havoc among the wooden war ships of the North, until the Southern craft met more than her match in the iron clad and revolving turreted "Monitor," which revolutionized battleship construction.

Appliances for Grinding Header Joints and Steam Pipe Rings

By CHARLES MARKEL
Shop Foreman, Chicago & Northwestern Railway, Clinton, Iowa

[illegible] idea and appliance just completed and doing very successful work at Clinton shops, cutting the time of grinding one superheater

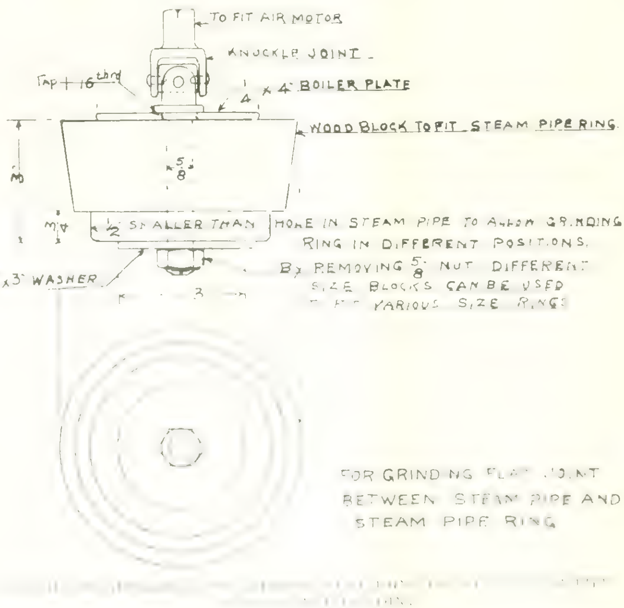


DETAILS OF DEVICE FOR GRINDING STEAM PIPE RINGS IN SUPERHEATER HEADER

header flat joint from four hours to one hour. Before this rig was made we simply stood up in smoke box and ground the two rings by hand, which was laborious work, and averaged four hours to complete one ring. The rig shown is made from 3/8-inch boiler plate, punched out as shown to lighten it, and two 1 1/8-inch holes located in frame to suit holes in header, which holes contain bolts which hold the rig in place. In the center of frame is screwed a piece of cast iron 3 inches diameter and 4 inches long, with hole through it 1 13/16 inches diam- [illegible] held in [illegible] sleeve in turn has 1 1/16-inch hole bored in it [illegible] hole [illegible] air motor, and the other end has attached to it a knuckle joint and star with four [illegible] the three 1-inch pieces riveted to frame. When in position ready to grind, oil and [illegible]

[illegible] gives the ring a movement of [illegible] inch on its grinding face, or, in other words, the eccentric motion gives the ring the same [illegible]

[illegible] the flat joint on steam pipe rings by air [illegible] fresh emery is applied, the trouble being that the moment the motor was held the least bit out of level, it would tip the ring and start it to jump and work its way off the surface being ground. The attached rig shows our method of motor grinding all flat joints by knuckle joint attachment, which allows the ring being ground to have all kinds of freedom to adjust itself



[illegible]

[illegible] hold the air motor. It will be noted that bottom part of knuckle has 5/8-inch stem and 1/4-inch plate washers top and bottom of wood block, which blocks are carried in tool room of various sizes to fit all sizes of steam pipe rings, and all that is required to change from one size block to other is to remove nut on end of stem. It will be observed that bottom of block is turned down back 3/4 inch and 1/2 inch smaller in diameter than hole in steam pipe, which acts as guide to hold ring in place, also to give ring the wabbling motion which is required. The idea of the knuckle joint, which is the secret of successful flat joint grinder, was suggested to me by Machinist Frank Shields, of Clinton shops.

Signal Accidents and Cab Control

By A. FRASER SINCLAIR

I suppose the dream of railway men of an infallible system of signaling is as old as railways themselves. Certainly in Britain much ingenuity has been devoted to the problem, much whitish gray matter in many brain-pans has been excited and worried in efforts to evolve something of a really practical and practicable nature, but it cannot be said that anything beyond promising experimental apparatus has up till now been produced. In recent years the need for automatic warning signals whether by sound or by vision has become clamant. Trains have grown in size, and their speed has been increased. When they were smaller, lighter and slower the firemen could assist the driver in the lookout for signals, and they could so divide up the work on the foot-plate that one pair of eyes was always on the signs ahead. Now, however, on many of the heavier routes, there are long stretches on end when the fireman's back is never straight, and the driver has to attend to the various other duties in the cab; and in some cases has even to go outside, oil can in hand, to attend to minor points requiring lubrication. This came out in connection with an accident which occurred at Aisgill, in the north of England, recently. Another accident of the kind occurred at Ilford, in the east of London. For some reason unknown a fast heavy train ran past the signals, alleged to [illegible] danger, and crashed into the side of a suburban train crossing from the east-going to the west-going lines. That, however, by the way. At a meeting of the British Institution of Mechanical Engineers held towards the end of last year the subject was under discussion, but it cannot be said that any very optimistic feeling prevailed regarding a solution in the near future. It would appear that the Great Western Railway has in use a system of audible signalling by which the attention of the engine crew is attracted without distracting their attention from what is going on ahead. But even that system has to be supplemented by means of visible signals within the cab for stopping purposes. There appeared to be a considerable diversity of opinion as to whether any solution was possible, and some of the members doubted the wisdom of attempting to substitute lifeless mechanism for human vigilance. Moreover there are very great mechanical difficulties in the growing interchange of rolling stock. On some railways the signal ramps are between the rails while they are outside the rails on others. This appears to be a question which will have to stand till the railways become the property of the nation, a development which the war has brought within the range of practical policies.

The Defects in Shoes and Wedges

By A. E. SCHEETZ, Shamokin, Pa.

In the construction of the modern locomotive the details of materials have been gone into pretty thoroughly, yet I think there has been some parts overlooked that could be made better. And that is the material from which driving box shoes and wedges are made. On the majority of roads cast iron is used with a mingling of a brass composition.

It seems to me that no machine can be better than its foundation, and surely the frame, boxes, shoes and wedges constitute the foundation of a locomotive.

Taking cast iron shoes and wedges first of all you have the varying hardness of the metal to contend with, which is a source of trouble in keeping the drivers perfectly square and in tram, since one shoe or wedge may wear so much faster than the others, thus throwing a pair of wheels ahead or back, or cocking them towards the others. This may be small, but if pairs are thrown in opposite directions the pound will not be long in making itself felt.

Another trouble is the pulling the bottom out of the wedge through the recess made for the wedge bolt head. Another fault is the breaking of the flanges of the shoes and wedges. This in itself should be enough cause on some classes of engines having thin flanges to determine to use something better than cast iron. I have seen cases, two in one day, where engines that had been overhauled had broken flanges, yet neither engine had made two hundred miles.

Now for brass shoes and wedges there is no disputing that so long as they retain their shape and are operative they make a fairly good shoe or wedge, but how long do they retain their shape? I have seen where they did right well; then I have seen cases where one wedge required ¼ inch of lining before the opposite wedge required any, and when the wedge was renewed it showed plainly that it was pounded out of shape, not worn. I have examined shoes and wedges that have not been in service more than a month, yet they were worn more than 1/16 inch; they were well lubricated and those showed signs of stresses by compression or pounding and pinching the frame. It no doubt may be shown by figures that the factor of safety for compression is fair, yet they show stresses by compression; this is no doubt caused by the tremendous blows that are struck as the reciprocating parts are brought to rest at the end of each stroke, and as the crank pin crosses the top or bottom quarter this blow becomes greatest when there is the most lost motion between the follower head and shoe and wedge. This will take up the play between the box shoe and wedge, the axle in the box and both ends of the main rod, and is in all engines really more than what is expected. This pound is so terrific that brass shoes and wedges cannot stand up under the strain, especially pool engines of 80 tons or more. Of course there are always favorable conditions and exceptions.

Then taking in account the expansion of brass by heat to that of steel we find that brass expands nearly twice as much as steel; this has a bad effect when journals have a tendency to heat, causing the boxes to stick.

Another factor is the softness of brass according to tests made by A. F. Shore with the Schroscope. Mild steel 5 c. = 26 to 30; gray castings = 39, and soft brass = 12, so we see by these tests that either steel or cast iron have an advantage over brass so far as hardness [illegible]

Now why not try steel; it has a great tensile strength, a good compressive strength, and a hardness next to gray cast iron. It is more uniform than cast iron. Its coefficient of expansion would be practically the same as that of the box and frame. The flange of a steel wedge could not be broken off so easily, neither could the bottom be pulled out; they would be much cheaper to make than brass.

The only reason that I know of for not using steel for this purpose is they say that steel to steel does not do very well. But I do not think this sufficient proof without trial that such is the case, for I contend that this is not purely sliding friction, but is pounding. I have seen steel liners put between the wedge and box, and when they were taken out they showed a clean, smooth, compact surface, and I can say that it was not caused by the use of oil as they were perfectly dry. If the same steel that the boxes are made of does not give satisfaction, why not try a composition somewhat dif- [illegible]

So far as I am able to find out there has never been any steel shoes or wedges used without a liner of some sort between the box and shoe and wedge. Possibly there is some of your readers that have tried steel; if so, let us hear from them and their results.

Mikado Type of Locomotives for the Georgia Railroad

First of Their Kind Running Between Augusta and Atlanta

[illegible] Corporation has [illegible] Georgia Railroad [illegible] of heavy modern [illegible] locomotives were [illegible] prepared by [illegible] department of motive power and equipment, and they represent the first engines of this type [illegible] Georgia Railroad. The design is entirely in accordance with [illegible] Mikado type [illegible] small be considered [illegible] to 220,000 pounds on drivers, and having 63-inch diameter wheel. The railroad company [illegible] modernizing this standard design, and therefore included in their equipment superheaters; brick arches; pneumatic firedoors; power reverse gears; graphite cylinder lubrica[illegible] truck and the "Austin" radial trailing truck, both of which represent the latest ideas in guiding and trailing devices for large locomotives. The tender is also carried on economy tender trucks, which are the first introduced into this section of the country.

It is interesting to learn that these [illegible] record of performances over the 171 miles of railroad between Augusta and Atlanta. About one-third of the distance is taken up with curves of which there are [illegible] There are only 7 miles of level grade, there being 131 ascending grades with an aggregate length of 96 miles, the total ascents being 2,669 feet, and 113 descending grades amounting to 1,786 feet. [illegible] curve is equal to an 0.82 grade on a straight track. The engines are so far in advance of anything hitherto in service on the Georgia Railroad that in comparison with the ten-wheel locomotives, still in service, with twenty-inch cylinders, the new [illegible] nearly double the capacity, [illegible] in the economic dispatch of the company's growing business.

The accompanying illustrations show that these locomotives are strongly designed, with heavy frames well cross-braced, and with large piston valves to distribute the steam to the 27-inch diameter cylinders. These valves are operated by the Southern valve gear, which is now quite well known in the district in which these engines will operate. This gear is neat in appearance and is reported to be quite effective.

The [illegible] throttle valves [illegible] been applied with outside connection and vertical lever. The auxiliary dome, just back of the main dome, is made in the shape of a manhole to admit of ready inspection of the boiler without taking down the throttle and other appliances. The Schmidt superheater is of the usual design with steam pipes and is made up of 36 elements. The frame braces at the main pedestal are extra heavy, and the equipment embraces the economy "Cole" patent box, the journal being 22 inches long, to overcome the pound that occurs at that point, especially when a superheating device is used.

The air brakes are served by two 11-inch Westinghouse pumps, discharg[illegible] capacity. Steel pilot beams are used at the front end and these are heavily reinforced by a cast steel filling piece which also acts as a guide for the engine truck center pin. All axles are of heat treated steel. Equipment includes electric headlight, with turbine located just in front [illegible]

The water supply is obtained by two Edna injectors discharging into a double top check manufactured by the same company. The strainers are of special design patented by the Lima Locomotive Corporation. The cab and running boards are of steel plate and the rear deck is of cast steel equipped with economy radial buffer connection to the tender. The coal wetting device is supplied by the Edna Brass Manufacturing Company. The 9,000 gallon water tank is of water bottom construction and has a retreating collar of neat design.

The general dimensions and ratios of this type of locomotive are as follows:

Gauge, 4 ft. $8\frac{1}{2}$ ins.; service, freight; fuel, soft coal; tractive effort, 53,200 lbs.; weight in working order, 280,800 lbs.; weight on drivers, 213,000 lbs.; weight on leading truck, 23,200 lbs.; weight on trailing truck, 44,600 lbs.; weight of engine and tender in working order, 454,800 lbs.

Wheelbase—Driving, 16 ft. 6 ins.; total, 35 ft. 2 ins.; engine and tender, 66 ft. $11\frac{1}{4}$ ins.

Cylinders—Kind, simple; diameter and stroke, 27 ins. x 30 ins.

Valves—Kind, piston; diameter, 16 ins.; greatest travel, 6 ins.; steam lap, 1 in.; exhaust clearance, line and line; lead, 3/16-in.; valve gear, type, Southern.

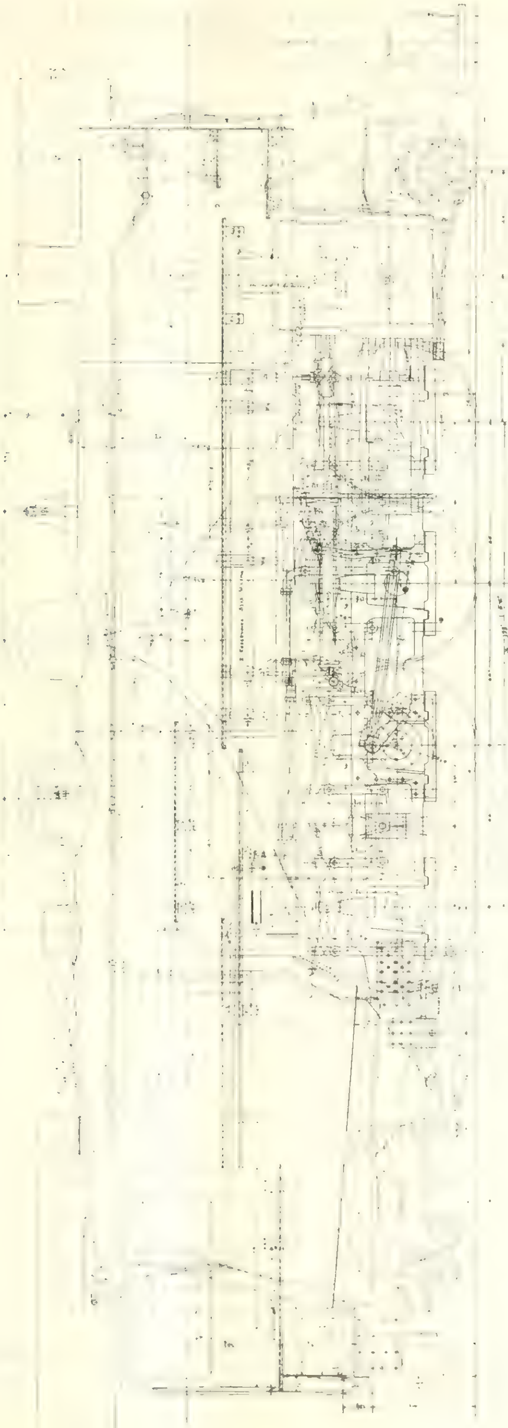
Wheels—Driving, diameter over tires, 63 ins.; tires, thickness, $3\frac{1}{2}$ ins.; journals, main, diameter and length, 11 ins. x 22 ins.; others, diameter and length, 10 ins. x 12 ins.

Engine—Truck wheels, diameter, 30 ins.; journals, 6 ins. x 12 ins.

Trailing Truck wheels, diameter, 42 ins.; journals, 8 ins. x 14 ins.

MIKADO TYPE OF LOCOMOTIVE FOR THE GEORGIA RAILROAD

[illegible] Lima Locomotive Corporation, Builders



GENERAL ARRANGEMENT OF THE DETAILS OF CONSTRUCTION OF MIKADO TYPE OF LOCOMOTIVES FOR THE [illegible]

[illegible] stayed; steam pressure, 180 lbs.; outside diameter of the first ring, 82 ins.

Firebox—Length and width, 120⅝ ins. x 84 ins.; plates, thickness, ⅜-in. x ½-in.; water space, 5 ins. all around.

Tubes—Material and thickness, steel, No. 11 B. W. G.; number and outside diameter, 275—2 ins.

Flues—Material and thickness, steel No. 9 B. W. G.; number and outside diameter, 36—5⅜ ins.

Tubes and flues, length, 20 ft. 6 ins.

Heating Surface—Tubes and flues, 3,974 sq. ft.; firebox and arch tubes, 262 sq. ft.; total evaporative, 4,236 sq. ft.

Superheating surface, 865 sq. ft.

Equivalent heating surface, 5,533 sq. ft.

Smoke Stack—Diameter, 19 ins. at choke; height above rail, 15 ft. 5 ins.

Tender—Frame, type, steel channels; wheels, diameter, 33 ins.; journals, diameter and length, 6 ins. x 11 ins.; water capacity, 9,000 gals.; fuel capacity, 13 tons

Ratios—Weight on drivers ÷ tractive effort, 4.

Total Weight ÷ tractive effort, 5.28.

Tractive Effort x Diameter Drivers ÷ Equivalent heating surface, 600.

Evaporative Heating Surface ÷ Grate area, 60.

Firebox Heating Surface ÷ Tubes and flue heating surface, 6.6 per cent.

Weight on Drivers ÷ Equivalent heating surface, 38.5.

Total Weight ÷ Equivalent heating surface, 52.7.

Volume, both cylinders, cubic feet, 19.86.

Equivalent Heating Surface ÷ Cylinder volume, 268.

Grate Area ÷ Cylinder volume, 3.54

Railroad Statistics.

In railroads there are said to be 1,500,000 holders of stocks and bonds, owners of this industry, representing at least 6,000,000 persons in the United States whom it thus helps to support. Railway bonds constitute 49 per cent. of all bonds held by savings banks.

20,000,000 persons, over one-fifth of the population, are directly or indirectly interested in the financial results of this industry.

$2,164,851,210 paid out by this industry in 1913 for expenses of all kinds, equivalent to $23.33 for every man, woman and child in the United States. Railroad income flows back to the people.

$129,191,880 paid in taxes in 1913 for the support of National, State and local government, equivalent to $1.43 for every inhabitant of the United States. The railroads are the country's largest tax-

Department of Questions and Answers

Brake Horse Power.

L. E., Holyoke, Mass., asks: How is the mechanical efficiency of a large stationary engine usually found when unable [illegible] meter to the fly-wheel or first motion shaft? A.—There is an instrument for measuring the power which an engine can give off for external work. The form of brake commonly used in the shops consists of wooden blocks, screwed to a light strap of hoop-iron or steel. It is best applied to a flywheel, and should be screwed together with a spring under the nut, so as to give a graduated pressure. Weights are hung from a hook, and the motion is checked by stops or chain. It should be well lubricated, and the wheel should be quite smooth. A brake on a six-foot diameter flywheel of five-inch face, at 150 revolutions per minute, easily absorbs thirty horsepower, and can be kept running for ten hours continuously without undue heating. The brake power is thus obtained. The common rule is to multiply the circumference of the brake circle in feet by the number of revolutions per minute, and by the suspended weight in pounds, and divide by 33,000; or, C = circumference in feet of brake circle; R = revolutions per minute; W = weight suspended.

[illegible] $= \frac{CRW}{33{,}000}$

Another form of brake, known as Floude's brake, is based upon hydraulic principles, the work being absorbed in overcoming the resistance of vanes in churning the water contained in a case. [illegible] stop [illegible] pass, thus altering the resistance that the [illegible]

Testing Applicants for Railroad Service.

M. De S., Albin, Cal., writes: What is the prevailing method used by the rail- [illegible] ing? What per cent. must be reached in physical examination to be accepted for engine service? What is the age limit for engine service? Is there an exami- [illegible] the [illegible] are submitted to the applicant for distinguishing colors, and printed letters are placed at certain distances, and both eyes are tested separately to ascertain at what distance the applicant can distinguish [illegible] judgment in accordance with the company's regulations in estimating the physical capabilities of applicants. In regard to the age limit it is generally from twenty-one to forty-five years, but in these and many other matters each railroad company makes its own regulations. There is no special examinations of applicants for wipers other than their apparent physical fitness, and their discharge will soon follow if found to be physically unfit for the service.

Heat in Smokebox.

S. N., Fitchburg, Mass., asks: What is the variation of heat in locomotive smoke-boxes when working, or standing still for any length of time? A.—When a locomotive is working hard under a high pressure, say 200 pounds per square inch, the heat in the smoke-box will run from 600 to 800 degs. Fahrenheit. The longer the flues the lower will be the temperature. With the engine standing still for any length of time, the heat will correspond nearly to the heat of the boiler. If the steam was at 30 pounds pressure the temperature would be 250 degrees, at 135 pounds, 350 degrees, and at 250 pounds, 400 degrees.

Brake Efficiency.

W. H. B., Leeds, England, writes: Will you please explain: (1) What is meant by the term "an overall efficiency of 10 per cent." as used in brake calculations for train stop distances in the November issue? (2) Are two brake shoes per car wheel more efficient than one shoe per wheel in stopping a car when the same percentage of braking power is used in both cases. (3) Would a brake be more effective if a brake gear could be arranged to pull the shoe down on top of the wheel instead of from in front or back of it? A.—The term "overall efficiency" as used in connection with the article you mention means percentage of brake rigging efficiency multiplied by the average coefficient of friction obtained, or, in other words, if the foundation brake gear is of such stability and the work imposed upon the brake shoe is not beyond its capacity to such an extent but that 10 lbs. actual retarding force can be obtained from the shoe on the wheel for every 100 lbs. calculated emergency braking ratio, the overall efficiency of the brake may be said to be 10 per cent. You will understand that in the design and installation of a brake the required pressure per brake shoe in pounds is calculated from the cylinder value (in pounds force delivered from the push rod) multiplied through the brake levers, and the poorer the design of foundation brake arrangement the greater the loss in power transmitted, especially when maximum braking force is used, hence the term "per cent. of brake rigging efficiency."

The Westinghouse-Galton observations of the coefficients of brake shoe friction that may be obtained were conducted in England in 1878, and are still an authority and reliable reference so far as they are applied to light construction of vehicles, moderate shoe pressures, and comparatively low brake shoe temperatures, but for modern construction of cars and locomotives Mr. Turner has discovered and repeatedly demonstrated that the average coefficient of brake shoe friction that can be obtained with the maximum braking forces now developed cannot exceed 10 per cent. (2) The two shoe per wheel installation known as the "clasp type of foundation brake gear" is not only more efficient than the standard single shoe design, but is an absolute necessity from a viewpoint of an efficient emergency brake for modern heavy trains running at high rates of speed. For light vehicles it cannot be said to be a necessity, but where brake shoe pressures are now so high that new shoes are completely worn out between terminals, where from ⅛ to ¼ of an inch of metal is worn from the shoe in a single stop, and where the temperature becomes high enough to warp the shoes and glaze the surfaces, and in some instances welds the steel back of the shoe to the beam, the clasp brake is necessary as it not only permits of halving the shoe pressure, thus lowering the degree of heat generated (in the brake shoes), and providing a greater area for dissipating the temperature, but it also makes possible the use of a much higher total brake leverage ratio which has in itself constituted quite an air brake problem dur- [illegible] of any attempts to locate the brake shoe in a manner that it would pull down on top of the wheel, consequently could not give you the results of any experiments or any information of practical value. You may have conceived this idea from [illegible] machines where the shoe is pulled down on the wheel by weights suspended from the brake lever, but so far as the brake shoe effect alone is concerned the point of contact will not materially alter the [illegible] braking effect from different locations of [illegible] such as wedging effect and absorption of power by the shoe hangers, and in low- [illegible] brake piston travel.

Mechanical and Scientific Notes

Grinding Copper.

In grinding copper on a carborundum wheel the copper invariably clogs. By rubbing tallow on the wheel this is prevented, and apparently the tallow does not interfere with the cutting qualities of the wheel.

Hardening Cutting Tools.

In hardening high speed steel taps, threading dies, reamers and milling cutters, it is good practice to insist on slow preheating in a furnace at 1,500 degs. Fahrenheit, and then submit to a temperature of 2,200 degs., or move to an adjacent furnace.

Tractive Resistance.

The tractive resistance on straight, level railroads is from 6 pounds to 18 pounds per ton, according to velocity; on tramways, 26 pounds to 33 pounds; on good stone pavement, from 44 pounds to 55 pounds; on good macadam roads, 44 pounds to 67 pounds, and on sand roads, from 130 pounds to 220 pounds.

Mottled Effect on Hardened Metal.

To secure a mottled effect on case-hardened work it is recommended that instead of dipping the part to be hardened all at once in the hardening bath, the dipping should be done jerkily. The result is that a series of mottled bars will be shown across the work, each bar denoting the position at the touching of the bath as the article was momentarily arrested in the plunge.

Blacking Brass.

Pour a strong solution of washing soda into a saturated solution of copper sulphate, then pour off the liquid from the resulting light-blue precipitate. Take the latter, dry it, then dissolve it in liquid ammonia. This will give a jet black color to brass when used fresh, but it will change to brown when the solution has been used for a time. The brass must be perfectly clean when the solution is applied.

To Prevent Rust.

The following preparation will keep machinery clear for months under ordinary circumstances, as, for instance, in a show-room. Dissolve an ounce of camphor in one pound of melted lard and add enough plumbago powder to make the mixture the color of iron. Clean the machinery, and smear it with the mixture. After it has stood for a day rub the work clean with a soft linen cloth. This will absolutely prevent rust.

Bluing Steel Screws.

Fill an iron pan nearly full of clean mahogany sawdust, and heat it to a dull red heat, and pass the articles through it, in and out, until the required color is obtained. The screws should be well polished and free from oil or grease, and not to be touched by the fingers before inserting in the pan. The higher the polish the brighter will the color be. If the screws are rubbed with powdered quicklime before inserting in the pan, all traces of grease will be thoroughly removed.

Welding Steel to Iron.

Make a flux compound consisting of iron or steel filings 100, salammoniac 10, borax 6, balsam of copaiba 5. Steel heated red, carefully cleaned of scale, the composition spread on it and the iron applied at white heat and welded with hammer. In the case of welding steel to cast iron, the steel after being shaped to correspond to the cast iron, should be heated cherry red, and then have borax applied to the surface. Then both steel and cast iron should be heated to welding heat, and strong pressure applied.

Wedge for Hammer Handle.

The difficulty of retaining a wedge in a hammer handle is well known, but it may be entirely prevented by taking an ordinary sheet-iron washer, about 1/16 in. in thickness, 7/8 in. outside diameter, and 1/4 in. hole. Place the washer edgewise in a vise, and file it sharp on about one-half of its outside edge. Then drive it into the end of the handle, leaving enough outside to file off to the shape of the handle. If it is driven tight enough the wood will swell into the hole in the washer and hold it tighter than any taper wedge even with jagged edges can be held.

Replacing Broken Tooth on Spur Pinion.

In general practice there are two ways of making a repair in a broken toothed pinion. A line of holes are drilled along the site of the missing tooth, and the holes are then tapped and pegs screwed in the height of the teeth. The pegs may then be filed in place to the correct shape of tooth. If this job is properly done, the peg tooth will outlast the wheel. A neater job, but not so strong, is to cut a dovetailed groove through the wheel, where the tooth is missing, sufficiently deep to hold firmly. Then cut off a piece of steel, fill up a tooth the exact shape of the other teeth, and shaped at the bottom to fit the groove. Drive the tooth into place and rivet over the ends.

Annealing Copper Pipes.

In the annealing of copper pipe it should be close-annealed—that is, heated in a close muffle or annealing-oven to a dull red heat for some time, and then either quenched in water or air-cooled, the former possibly being the best, but also the most troublesome. It is important that the heating shall be regular, and that it should continue for a sufficient time to permit of the necessary molecular or granular changes incident to the softening of the metal. For short lengths it would not be difficult to erect a small gas furnace and close-muffle; but with long lengths the matter would be rather troublesome. For purposes where exactness is not of importance, if you pass the copper through a gas or other fire until it is red hot, and cool in the air. This will soften the metal so that it may be bent; but it will not draw properly, neither can it be depended on for resisting internal pressure, as it will not be really annealed, nor will it be of the same degree of softness throughout, hard places occurring.

The Laws of Friction.

1. Friction is greatly influenced by the smoothness or roughness, hardness or softness of the surfaces rubbing against each other.

2. It is in proportion of the pressure, or load; that is, a double pressure will produce a double amount of friction, and so of any proportionate increase of load.

3. The friction does not depend upon the extent of surface, the weight of body remaining the same.

4. The friction is greater after the bodies have been allowed to remain for some time at rest in contact with each other than when they are first so placed; as for example, a wheel turning upon gudgeons will require a greater force to start it after remaining some time at rest than it would at first. The friction of car journals is increased temporarily when the car has been standing for hours.

5. The friction of axles does not depend upon their velocity; thus a railroad car traveling at the rate of 20 miles an hour will not be retarded by friction more than another which travels only 10 miles in the same time. So the amount of friction is as the pressure directly without regard to surface, turn or velocity.

6. Friction is greatly diminished by ingenuity, and this diminution is as the nature of the unguents, without reference to the substance moving over them. The kind of unguent which ought to be employed depends principally upon the load; it ought to suffice just to prevent the bodies from coming in contact with each other. The lighter the weight, the finer and more fluid the lubricant should be in order to reduce the friction.

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Daylight in Railway Shops.

[illegible] railway operating at the present time [illegible] so obvious that nothing seems too trivial [illegible] made. Since the International Railway Shop Foremen's Association has been formed the members have shown them- [illegible] operations when the expense involved was not great, but in our visits to repair [illegible] been displayed towards the improved [illegible] light is cheaper and more efficient than artificial light. Since brilliant electric lights came into use, it seems to us that their glare is frequently preferred to daylight that can be secured without expense.

In old shops, built when it was the fashion to make small windows and low roofs, the need of extra light is often seriously felt and there is every excuse to resort to artificial lighting, but we have been sorry to notice that frequently in such shops, daylight is not admitted so freely as it might be. It is a matter for wonder that in shops where the windows are the smallest, and daylight obstructed by adjoining buildings, the accumulation of smoke taint and dust upon the glass and walls is usually the most conspicuous. There are many railroad shops along the lines of the older roads in which the cost of artificial light might be saved for two or three hours every day in winter by washing the windows and whitewashing the black walls.

In shops where the mistake was made by having windows too small, a good paying investment it would often be to enlarge them at considerable expense and lower their location to the level of the work benches, and raise the upper part as high as practicable. A single foot added to the length of the window sometimes has the effect of nearly doubling the light producing powers. Such changes are usually objected to on the ground that it is not expedient to go to the expense of making changes and alterations on old shops because it is expected that new modern buildings will be erected in a few years. That idea has proved a very expensive fallacy. The years slip by and the new shops are not built or even contracted for, while in the meantime lighting bills, short hours, diminished quantity and poorer work, with other sources of expense arising from insufficient lighting more than equal the cost of making the necessary alterations.

Electricity Direct from Coal.

One of the [illegible] scientists [illegible] the generation of electricity direct from [illegible] The present method of burning coal in a furnace to convert water into steam that will drive an engine to operate an electricity producing [illegible] its following could be eliminated and the potential energy of coal converted directly [illegible] would result.

Numerous investigations have carried [illegible] converting carbon energy to electricity [illegible] Dresden, Germany, has patented an invention for the practical production of electric light without the intervention of boiler, engine or dynamo.

Nearly a hundred years ago it was discovered that two metals joined at one end and made hotter than the junction at the other end would generate a current of electricity through the metals. But the amount of electricity made by one such combination is always too small for practical use in lighting. The present invention consists of a furnace containing a series of such thermopiles made of heat-resisting metals, and is said to deliver a practical lighting current for a somewhat less fuel cost than the best steam engines. The first cost of the plant should be very considerably less.

Elimination of the middle man, the favorite panacea for reducing the cost of living, is but an idle dream compared with the elimination of middle processes between coal, the original source of most of our power, and the usable power of electricity itself. There is a certain mathematical relation between heat and power, whether expressed as horsepower or kilowatts. If it were possible to turn into power all the heat contained in a pound of good coal it should theoretically produce 5½ horsepower or 4 kilowatts for an hour. But in the roundabout way we now extract this power, we lose at every point, getting no more than 70 per cent. of the total through the boiler, 30 per cent. of this through the engine, and 90 per cent. of the engine power into electricity, finally realizing in electricity less than one-fifth of the whole force of the coal, say three-fourths of a kilowatt hour. Thus there is a theoretical possibility to do five times as much with a pound of coal as is now being done. Of course there would always be some losses, but here is margin enough to encourage inventors of radical departures from present methods.

Thought and Labor.

It is no less a fatal error to despise labor when regulated by intellect than it is to value it for its own sake, says Ruskin, that king of fair philosophers. We are always in these days trying to separate the two. We want one man to be always thinking and another to be always working, and we call one a gentlemen and the other an operative, [illegible] the worker [illegible] often to be thinking, and the thinker often to be working, while both should be gentlemen in the best sense. As it is we make both ungentle, the one envying, the other despising, his brother, and the mass of society is made up of morbid thinkers and miserable workers. Now it is only by labor that thought can be made happy, and the professions should be liberal, and these should be felt in peculiarity of employment and more in excellence of achievement.

Casehardening and Potashing.

Casehardening, or the method of having soft iron coated with hard steel, requires more skill than is generally attributed to the proper manipulation of the process in order to obtain the best results. It is a very important advantage in machine construction that the work of machining and fitting can be done on soft metal and then the parts hardened to a sufficient depth, combining in a very high degree the elements of durability and elasticity.

The common method is to have the articles packed in boxes which in many instances are too large. It is noteworthy that the thinner the boxes are the more equal will the absorption of the carbon take place. Malleable cast-iron boxes are the best, and the packing may be bone or leather cuttings, hoofs or horns. These may be used raw or after conversion into charcoal. A layer of the material should be placed in the bottom of the box, then a number of the articles to be case-hardened should be laid sufficiently far apart form each other so that there can be no possibility of contact. Powdered potassium cyanide or prussiate of potash in the form of dust should be shaken over the articles during the process. The packing should be thoroughly dry. The parts of the articles that are desired to remain soft should be covered with fireclay or pipeclay mixed with white ash from the boxes. Only the parts to be hardened should be in contact with the carbonizing material, and if this is carefully attended to the results will be satisfactory. It is well in all cases to have the covers of the boxes pierced with small holes for the insertion of testing wires to show the degree of heat and consequent penetration of the carbon.

In the oven the heat should be maintained at a steady temperature of about 1,700 degs. This will heat the articles to a bright cherry red. This should continue from 10 to 12 hours. The time occupied in the heating process is an important factor in the operation, the longer period for the duration of heat deepening the thickness of the eventually hardened surface. It is good practice to withdraw a wire from time to time, and after cooling the wire it can readily be broken by a hammer, when the depth of hardening can readily be seen.

The cooling process should be done as rapidly as possible. Running water is the best for cooling, but as that cannot always conveniently be had, solutions of salt, cyanide and other chemical may be used to increase the coldness of the water. The hardening should penetrate at least 1/16 in. A formula for making case-hardening mixture [illegible] chemicals is often used where horns, hoofs and bones are not to be had in sufficient quantities. The mixture consists of 16 parts of lamp-black, 18 parts of salsoda, 4 parts muriate of soda, and 1 part of manganese.

It may be added that potashing is sometimes conveniently used in surface hardening. The operation consists of heating the article to be treated to a bright red, being careful not to let it scale from excessive heat; then cover the heated surface with the prussiate of potash, which will readily fuse and spread over the heated metal, which should be again placed in the fire to completely fuse the solution, after which the article is dipped in cold water. The cooling should be as rapid and equable as possible, to prevent warping, which in the case of curved or thin articles is sometimes unavoidable, but can be guarded against by careful handling of the articles at the moment of contact with the water.

When the Brick Arch Was Coming into Favor.

When the use of the brick arch was struggling into favor the following testimony was given by a master mechanic who went out for himself to investigate the value of a device that was by no means regarded with universal favor: "The road runs very heavy express passenger trains out of Boston, with heavy engines capable of doing the work expeditiously. I rode on one of these engines when it was pulling 14 heavy passenger cars, among them several sleepers. Starting from Boston there is a long grade of 35 feet to the mile, on which the train has to be hauled at a speed of about 50 miles an hour. This calls for hard work, as every engineman knows.

"The engines had plain fire boxes when first started upon this work, but a few weeks before I rode upon them a brick arch was put into each fire box. During the severe test of the starting pull the steam was kept close to the popping point. The fireman told me that before the brick arch was put in he never could get over the hill without losing twenty pounds of steam, but since the engine had the arch he could always keep up a full head of steam with the firedoor on the latch."

The Mechanical Organization of Railroads.

To meet the complex responsibilities of the mechanical side of railroad operation, and maintain the equipment in a state of preparedness demands, as in every other department of the business, a balanced and efficient organization, whose members shall be [illegible] by the animated pursuit of a common purpose.

The usual staff organization [illegible] department [illegible] officer, styled superintendent or general superintendent of motive power, mechanical or general mechanical superintendent, superintendent of machinery, or other title, appropriate to the office. On the larger roads the chief mechanical officer, as a rule, is assisted by one or more deputies, bearing various titles, who have general authority and, sometimes, have direct supervision of the shops, thus standing between the shop organizations and the chief of the department. Not infrequently there is an officer charged with responsibility for the work of the car department, with the title of superintendent of car department, or master car builder. On the Erie Railroad there are three mechanical superintendents. One has general charge of all car work of the system. One is assigned to each grand division of the road, in direct charge of the locomotive shops and has concurrent jurisdiction, in a restricted sense, over car work in his territory. The other regular staff officers are a mechanical engineer, electrical engineer, engineer of tests, chemist, chief boiler inspector and general inspectors of various grades and diverse duties. The larger roads add to the above two general officers who are absolutely indispensable where there is any pretense of practicing the higher phases of railroad economy, using that term in the scientific sense. These are efficiency engineers who are in charge of shop costs.

Night Work Expensive.

A member of one of the railway clubs has been investigating the subject of night work in repair shops and the contention arrived at is that working with artificial light is an expensive practice. He says that work performed under artificial light is of an inferior quality because the delicate touches that go to make first class work cannot be brought out by candlelight, which is an old saying among mechanics. The same observer also adds:

"Work done at night is not satisfactory in quality as compared with that done by daylight. The quantity of work turned out after lamps are lighted is insignificant considering the time taken. In other words, loafing becomes persistent with the failure of light. Night shifts [illegible] little work as compared with the day [illegible]

While the electric light does something towards sufficient lighting the shop, it is lacking in several of the most important requisites. Its bluish color is bad and does not properly illuminate cast or wrought iron. Oil is cheap, but does not [illegible] mand, "Work while it is day, for the [illegible]

American Business Locked Out.

Mr. Charles M. Muchnic, of the Baldwin Locomotive Works, who spoke some time ago at a Saturday luncheon of the Republican Club of New York City, said that American business has been locked out of South American countries to a large extent by the investment there of European capital, on the understanding that the country furnishing the capital [illegible].

"Another instance that comes to my mind," he said, "is the Manila Railroad Company, a railroad operated on American territory with government representatives on the board of directors, and securities for that road largely guaranteed by our government. Yet the entire management of that company, from the presi[illegible] are Englishmen, who delight in criticising [illegible] American origin.

"After many years of effort the Baldwin Locomotive Company was only once allowed to participate in competition for the purchase of locomotives, and while the contract was in that instance awarded to us on the basis of price, and only after pleading our case with the Bureau of Insular Affairs, we were obliged to build the locomotives to English design and English specifications. When the engines were delivered they were subjected to the severest criticism by the English management, inspired solely by prejudice against American products. Other orders for locomotives have since been placed in England without American manufacturers being invited to tender bids. The same applies to many other purchases made by this railroad, which is the most important in the Philippine Islands."

United States control of insular posses[illegible] differently from the practi[illegible] they are in control. The exercise of a [illegible] more authority [illegible] [illegible]cturers.

Waste from Lower Flues.

[illegible] to improve the economical operation of locomotives seldom become popular unless they are pushed into use by influences that call for their adoption. It is well known that the lower flues placed in most locomotive boilers are troublesome to keep tight, and that the increase of heating surface they represent is of no real value, yet nearly all railway companies persist in applying and retaining them. Mr. J. W. Kelly read a paper at the Western Railway Club in which he took a strong stand against the first railway practice of putting the upper flues too close to the crown sheet and the lower ones in the position where they readily become choked with cinders.

Mr. T. W. Bentley, assistant superintendent of machinery of the Chicago & Northwestern Railway, discussing Mr. Kelly's paper, said that at the instigation of Mr. Kelly they had left out fifty of the bottom flues, and it has resulted in tremendous improvement to the economy of the engine. He said "that before this change was made many an engine stopped on the road because the bottom flues were leaking. Now they do not leak because the flues are not there, and the other flues do not seem to cause so much trouble, and the engines steam just as well. Leaving out a number of bottom flues is now our standard practice on certain engines, and we are securing better results from them."

That is what Jim Skeevers used to call "a good object lesson." We wonder how many railroad companies are heeding these words that mean saving of purse and avoiding trouble?

Cheating the Railways.

It is a notorious fact that the heads of our government bureaus conserve their own interests at the expense of the people at large, and that the officials of the Post Office Department exert themselves strenuously to oppress railroads. Senator Bourne, who has devoted particular attention to post office matters, is credited with saying that the history of the dealings between the government and the railways affords a perfect example of "bureaucracy run mad." The officials who take the lead in acting unfairly towards railway interests think that they have the public support, which is a serious mistake. The American public wish to act fairly towards all the interests that are serving them. President Wilson is reputed to be a thoroughly fair head of the government. We think it a great pity that he fails to devote close attention to the doings of [illegible] that are inflicting hardships upon railways and other interests.

To go into an exact cause of complaint Mr. Howard Elliott, president of the New York, New Haven & Hartford Railroad asserts that his railroad is underpaid $1,000,000 yearly on the business it does for the government. Similar conditions exist all over the United States and does [illegible].

Noble Engine Drivers.

[illegible] writer about the treatment he received when he stepped into the cab of a locomotive in a Chicago station and offered to run the engine. "The driver turned rudely to me," his lordship said, "and exclaimed: 'Go to h— and get off this engine.'"

His lordship was only requesting a privilege that is sometimes still accorded to influential personages in Europe, but never was practiced on the American continent. In the old coaching days it was considered perfectly correct and rational for gentlemen of an enterprising character and sporting taste to take the reins and act as driver, and many a coach load of innocent passengers have been tumbled into the ditch through the recklessness or stupidity of noble amateur drivers. When stage coaches gave place to railways the noble idiots who found delight in driving stage coaches considered it was even more amusing to try their hands on running locomotives. Before the practice was stopped by rigid rules strictly enforced, forbidding people outside of the train crew from riding on the engines, many a superintendent was sorely annoyed which the privilege influential persons solicited of riding on the engines when they felt like doing so. Many lords of high degree used in those days to boast that they had "driven" locomotives over every line between London and Inverness.

Safety First.

A great deal has been said of the origin of safety movement. It will interest manufacturers to know that the earliest record of systematic eye protection is that of Crane Company, Chicago, which in 1897 began to provide eye protectors for its men and in 1898 put this work on a systematic basis, giving the glasses to the men free of charge and requiring operators, as far as possible at that time, to wear the glasses constantly when they were exposed to flying bits of metal, emery, dust, glare and hot metal.

Air Brakes Thirty Years Ago.

At a meeting of the New York Railroad Club in February, 1885, at which Leander Garey presided, the subject of "Freight Train Brakes" was discussed, and most of the members, including M. N. Forney and Mr. Garey, expressed the opinion that air brakes could not be used successfully on freight trains unless such trains were very short. That was no doubt true with the air brake as developed at that time.

The coal used for locomotive boilers in the United States ranges from low-grade bituminous coal that closely resembles lignite, ranging up by imperceptible gradations to nearly fair carbon as found in the best anthracite. Each grade of coal ought to receive treatment in firing adapted to its chemical composition, but in most cases all qualities of coal are treated alike; good, bad and indifferent are supposed to make steam equally well.

Trautwine on Higher Mathematics.

Not a few of the people who attend night schools and other institutions where ambitious workmen are supposed to receive scientific instruction, complain that they are unable to grasp the mathematics of engineering. Our advice is keep working and you will soon acquire all the mathematics that practical engineers need to learn. Some remarks made by the late John C. Trautwine, author of "Rules and Tables for Engineers," may be comforting to people struggling up the steep grade of self-instruction. Mr. Trautwine stood in the highest rank among engineers, and his book has been one of the most valuable aids to the profession, so his opinion about mathematics is worthy of consideration. He said, while referring to the great engineering works completed by Rankin, Weisbach and others, that their profundity of knowledge is beyond the reach of ordinary men, and that their language is also so profound that few engineers can read them. He had long since forgotten the little higher mathematics he once knew. To him they were but little more than striking instances of how completely the most simple facts can be burried under heaps of mathematical mysteries.

Adhesive Alloy.

A soft alloy which adheres so firmly to metallic, glass or porcelain surfaces that it can be used as a solder, and which is invaluable when the articles to be soldered are of such a nature that they cannot bear a high temperature, consists of finely pulverized copper dust, which is obtained by shaking a solution of sulphate of copper with granulated zinc. The temperature of the solution rises considerably, and the metallic copper is precipitated in the form of brownish powder—20, 30 or 36 parts of this copper dust, according to the hardness desired, and placed in an iron or porcelain-lined mortar and well mixed with some sulphuric acid having a specific gravity of 1.85. Add to the part thus formed 70 parts by weight of mercury, constantly stirring. When thoroughly mixed the amalgam must be carefully rinsed in warm water to remove the acid and then set aside to cool. In ten or twelve hours it will be hard enough to scratch tin. When it is to be used the amalgam should be heated to a temperature of 700 degs. Fahr. When it becomes as soft as wax by kneading it in an iron mortar. In this ductile state it can be spread upon any surface, to which, as it cools and hardens, it adheres very tenaciously.

On the Job.

There are two kinds of clock watchers: One sees how much longer he must work before he can go home—the other sees how much longer he can work before he must go home.

New Honor to Walter V. Turner

Inventor of the Electrically Controlled Air Brake System

Last month's issue contains certain extracts from a Pennsylvania Railroad bulletin on the subject of the electrically-controlled air brake system which is being installed on the passenger trains of that road. This brake was designed and perfected by Mr. Walter V. Turner, of the Westinghouse Air Brake Co., and in recognition thereof was awarded

WALTER V. TURNER
Assistant Manager, Westinghouse Air Brake Company.

the Elliott Cresson gold medal by the Franklin Institute of the state of Pennsylvania, which is the highest honor that this most scientific body of men in America can confer upon any scientist.

In connection with the photograph of Mr. Turner and facsimile of the medal, we wish to state that he is unquestionably the greatest living authority on air brakes and air brake subjects and while

ELLIOTT CRESSON GOLD MEDAL [illegible] TO WALTER V. TURNER.

the medal was awarded for air brake inventions and developments, and while the actual number of inventions run into the hundreds, we cannot associate his life work with ideas of invention because of the general conception, or possibly misconception, of this faculty and moreover Mr. Turner is an engineer and his inventions are merely incidental to the solution of mechanical and engineering problems of such magnitude and involving such an intricate mass of details and analysis of factors that no one but the air brake expert or the scientist is able to comprehend the marvelous results that are now achieved from variations in compressed air pressure in a single line of pipe connecting the cars of a railroad train.

We say that he is the greatest air brake expert that the world has ever produced, because he has developed a perfect control of modern trains from a comparatively crude mechanism and incorporated therein those desirable feattures which air brake experts had agreed upon as being impossible to obtain and because his practical experience ranges from car repairer on the Santa Fe Railroad to chief engineer of the Westinghouse Air Brake Co., and we are equally positive that he is the best informed man on air brake subjects because the Air Brake Association has for years submitted questionable subjects for his decisions and accepted his replies without question, this association considers him to be the perfect instructor, a brilliant lecturer and a talented author who can, without special preparation, talk a technical contribution to air brake literature.

This medal is but one of many honors that have been conferred upon Mr. Turner, and the Franklin Institute recognizes him as one of the most scientific men in America and RAILWAY AND LOCOMOTIVE ENGINEERING regards him as a man who was sought to "build up the wall and stand in the gap," and who was able to arise to the occasion.

Mr. Turner is now assistant manager of the Westinghouse Air Brake Co., and has been contributing an article to our columns each month, and we feel sure that our readers will appreciate our efforts to provide a character of air brake literature such as no other technical publication has ever been able to offer its readers, and we hope to continue this high standard.

Proceedings of the American Electric Railway Association.

[illegible]ciation has published, in a cloth-bound volume, the Proceedings of the American Electric Railway Association, 1914, containing a complete report of the 12th annual convention, held at Atlantic City, N. J., October 12 to 16, inclusive, of last year. There are nearly 600 pages in the book, and a valuable feature is the indexing, which is unusually complete and thorough. The office of the secretary of the association is 29 West 39th street, New York City.

Locomotives for the Nashville, Chattanooga & St. Louis

Fine Examples of the Mikado and Pacific Types

[illegible] has [illegible] and six [illegible] the Nash[illegible] Railway [illegible] particularly large for their respective types, are equipped with fuel-saving devices and [illegible] modern [illegible].

[illegible] exert a tractive force of 49,500 pounds, and are [illegible] built for this [illegible] Works. They are equipped with Schmidt super[illegible] and are so designed that standard stokers [illegible] desired. [illegible] depth of [illegible] the under[illegible] of the [illegible] electrically [illegible]

[illegible] weight distribution on the two sides of the locomotive when passing over uneven places in the track, and also reduces stresses in the [illegible] and equalizing gear.

The general dimensions of this type of locomotive are as follows:

Gauge, 4 ft. 8½ ins.; cylinders, 25 ins. x 30 ins.; valves, piston, 15 ins. diameter.

Boiler—Type, Wagon-top; diameter, 76 ins.; thickness of sheets, 11/16-in., 23/32-in., ¾-in.; working pressure, 180 lbs.; fuel, soft coal; staying, radial.

Firebox—Material, steel; length, 114⅝ ins.; width, 84¼ ins.; depth, front, 85¼ ins.; depth, back, 72½ ins.; thickness of sheets, sides, ⅜-in.; back, ⅜-in.; crown, ⅜-in.; tube, ½-in.

Water Space—Front, 5 ins.; sides, 5 ins.; back, 5 ins.

Tubes—Diameter, 5⅜ ins. and 2 ins.; material 5⅜ ins., steel; 2 ins., iron; thick[illegible] W. G.; number, 5⅜ ins., 34; 2 ins., 241; length, 20 ft. 6 ins.

Heating Surface—Firebox, 224 sq. ft.; [illegible] sq. ft.; total, 3,804 sq. ft.; grate area, [illegible]

[illegible] ins.; center, 50 ins.; journals, main, 10[illegible] ins. x 21 ins.; others, 9½ ins. x 12 ins.

Engine Truck Wheels—Diameter, front, 33 ins.; journals, 5½ ins. x 12 ins.; diameter, back, 36 ins.; journals, 8 ins. x 14 ins.

Wheel Base—Driving, 15 ft. 9 ins.; rigid, 15 ft. 9 ins.; total engine, 34 ft. 4 ins.; total engine and tender, 69 ft. 7 ins.

Weight—On driving wheels, 205,000 [illegible] 20,000 [illegible] truck, back, 38,600 lbs.; total engine, 264,300 lbs.; total engine and tender, about 420,000 lbs.

Tender—Wheels, number, 8; diameter, 36 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 8,500 gals.; fuel capacity, 14 tons; service, freight.

Locomotive equipped with Schmidt superheater. Superheating surface, 840 sq. ft.

The Pacific type locomotives are generally similar to the Mikados, although they have smaller cylinders and boilers and the wheel-loads are somewhat lighter. The tractive force exerted is 32,000 pounds, with a ratio of adhesion of 4.48. As in the Mikado type locomotives, the spring rigging is cross equalized back of the rear driving-wheels. The boiler center line is placed 9 ft. 6 in. above the rail, and this allows room for a furnace throat as deep as that applied to the Mikados. With a superheater and brick arch, and a boiler having ample furnace [illegible] and heating [illegible] these locomotives should prove free steamers.

[illegible] TYPE OF LOCOMOTIVE FOR THE NASHVILLE, CHATTANOOGA & ST. LOUIS RAILWAY.
[illegible] Baldwin Locomotive Works, Builders.

The cylinders are arranged with outside steampipes, and the distribution is controlled by 15-inch valves which are set with a lead of 3/16-inch. Neither relief nor by-pass valves are used. The [illegible] the pistons, which have cast steel dished bodies with iron bearing shoes cast on. The width of the piston head is 5[illegible] inches.

These locomotives are equipped with Cole [illegible] main driving boxes, and with the latest design of Hodges trailing truck. The spring rigging is cross equalized between the rear driving wheels and back truck. This is done by pinning together, on the center line of the locomotive, two [illegible] connected by links with the rear driving-[illegible] with the rear truck equalizers. This con[illegible]

The tenders of both types are of the Vanderbilt pattern, carried on "Standard" [illegible] and roller [illegible] The [illegible] wheels [illegible] of the same make.

The general dimensions of this type of locomotive are as follows:

Gauge, 4 ft. 8½ ins.; cylinders, 23 ins. x 28 ins.; valves, piston, 13 ins. diameter.

Boiler—Type, Wagon-top; diameter, 66 ins.; thickness of sheets, 9/16 ins. and ⅝-in.; working pressure, 185 lbs.; fuel, soft coal; staying, radial.

[illegible] Material [illegible] length, 114[illegible] ins.; width, 66 ins.; depth, front, 74 ins.; back, 63 ins.; thickness of sheets, sides, [illegible] back [illegible] crown [illegible] in.; tube, ½-in.

Water Space [illegible] sides, 4 ins.; back, 4 ins.

Tubes—Diameter, 5⅜ ins. and 2 ins.; material, 5⅜ ins., steel; 2 ins., iron; thickness, 5⅜ ins., No. 9 W. G.; 2 ins., No. 11 W. G.; number 5⅜ ins., 24; 2 ins., 186; length, 20 ft. 6 ins.

Heating Surface—Firebox, 186 sq. ft.; tubes, 2,678 sq. ft.; fire-brick tubes, 27 sq. ft.; total, 2,891 sq. ft.; grate area, 52.4 sq. ft.

Driving Wheels—Diameter, outside, 69 ins.; center, 62 ins.; journals, main, 10½ ins. x 12 ins.; others, 9½ ins. x 12 ins.

Engine Truck Wheels—Diameter, front, 36 ins.; journals, 5½ ins. x 12 ins.; diameter, back, 44 ins.; journals, 8 ins. x 14 ins.

Wheel Base—Driving, 13 ft. 0 ins.; rigid, 13 ft. 0 ins.; total engine, 34 ft. 1 in.; total engine and tender, 69 ft. 4 ins.

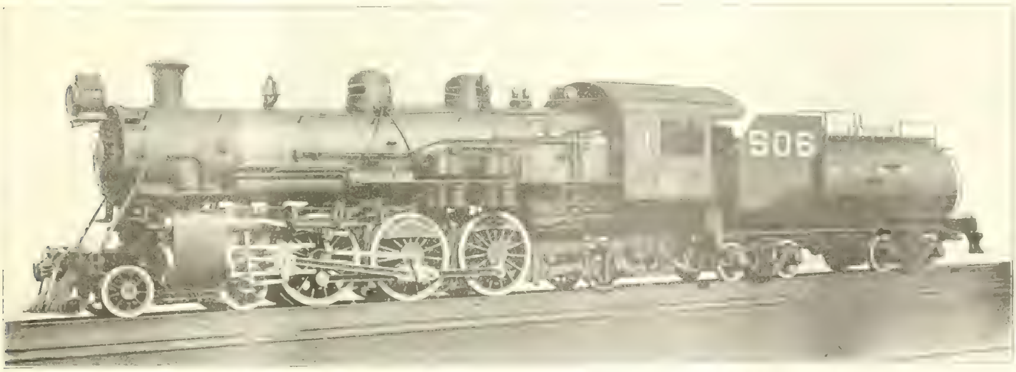
Weight—On driving wheels, 143,500 lbs.; on truck, front, 37,400 lbs.; back, 38,650 lbs.; total engine, 219,550 lbs.; total engine and tender, about 375,000 lbs.

severe service conditions; and this fuel is therefore specially suitable for large locomotives in which high powers must be developed for sustained periods.

The largest engine in the group, however, is a coal burning locomotive. This locomotive, which is of the 2-10-2 type, was built for the Chicago, Burlington and Quincy Railroad, and is equipped with the latest design of Street mechanical stoker. All of the locomotives composing the exhibit were built in the regular course of business, and embody special features of construction adopted by the companies whose names they bear. They will be placed in regular service at the close of the exposition and consist of a Pacific type locomotive of the Atchison, Topeka & Santa Fe system. This locomotive is intended for service on the Pacific Coast Lines and is equipped for oil burning, although it can be readily fitted for coal burning. The Baker valve gear is applied and also superheating appliance. This fine locomotive develops a tractive power of 41,000 pounds.

curves when running in either direction. The trucks are of the radial type, the front truck being centre bearing and the rear truck side bearing. As the trucks are equalized with the driving wheels, each wheel finds a bearing and carries its share of the load when the engine is passing over uneven roads. It is suitable for working on curves of thirty degrees, and grades up to seven per cent. A novel feature is a small rotary air engine geared to a screw for working the power reverse mechanism.

Another interesting Mikado type built for the McCloud River Railroad has the firebox placed back of the driving wheels and over the rear truck, which is of the Rushton type. The Walschaerts valve gear is applied. This type of engine is well adapted for the timber regions of the northwest where hundreds of million feet of white and sugar pine lumber are annually handled over this line, the work being done chiefly by Mikado type locomotives.



PACIFIC [illegible] TYPE OF LOCOMOTIVE FOR THE NASHVILLE [illegible] ST. LOUIS RAILWAY

J. J. Sullivan, Superintendent [illegible] [illegible]

Tender—Wheels, number, 8; diameter, 36 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 8,500 gals.; fuel capacity, 14 tons; service, passenger.

Engine equipped with Schmidt superheater. Superheating surface, 592 sq. ft.

Baldwin Locomotive Works Exhibit at the Panama-Pacific International Exposition.

An admirable exhibit has been established by the Baldwin Locomotive Works at the Panama-Pacific International Exposition. A group of six locomotives represent types intended for different classes of service, and they indicate the present trend of locomotive development. With one exception they are intended for service in districts where oil is plentiful, and are equipped for burning oil fuel. Oil-burning locomotives in recent years are proving highly successful, as full steam pressure can be carried under the most

A Mikado type 2-8-2 built for the San Pedro, Los Angeles & Salt Lake [illegible]ted for heavy freight or passenger service on heavy grades, where moderate speeds will suffice. With driving wheels sixty-three inches in diameter the locomotive is finely adapted for mountain climbing and develops a tractive force of 51,000 pounds. The Ragonnet power re-[illegible]

Another Mikado type built for the Southern is of similar dimensions, with a variation in the truck arrangement which is of the improved Hodges pattern. The tender is also of the Vanderbilt type with cylindrical water-tank, and is fitted with a vestibule connection at the rear end. Both of these Mikado locomotives develop high starting tractive force.

A Mikado type locomotive for logging service is shown, and the wheel arrangement is adapted to safely enter sharp

National Transcontinental Railway.

Notice has been given in the Dominion House of Commons at Ottawa of a resolution which contemplates the continued operation by the Government of the National Transcontinental Railway from Moncton to Winnipeg as a part of the Government's system of railways. In order to secure an outlet on Lake Superior it is proposed to lease or purchase from the Grand Trunk Pacific Railway their branch line running from Lake Superior Junction to Fort William, including terminal facilities, rolling stock and equipment. The Minister of Railways is to be empowered, with the approval of the Governor in Council, to carry out such an agreement, lease or purchase.

The amount of new territory opened by the Transcontinental railway is amazing when it is considered that the country was considered almost unfit for habita-

Air Brake Department

Improved Freight Brake

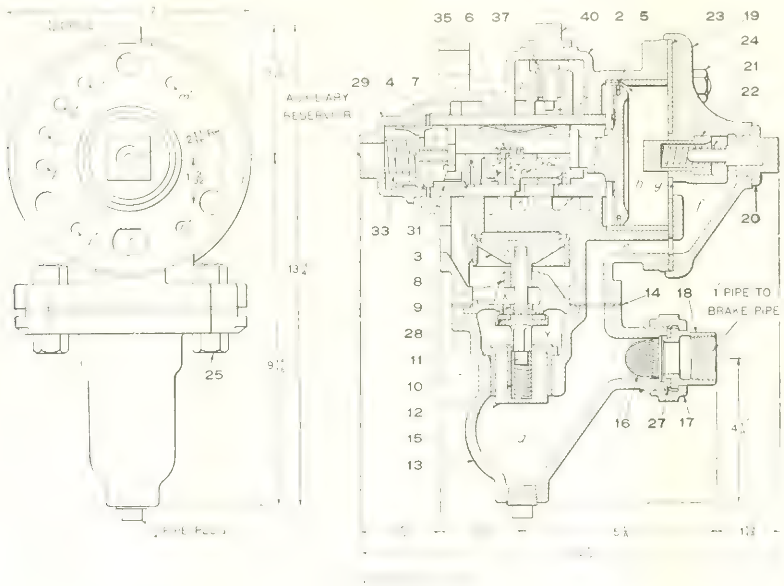
Equipoise in Accelerating and Retarding Force

The design of an empty and load brake for freight cars would be a comparatively simple proposition if it were not necessary to consider the volume of compressed air to be transmitted in operating long freight trains. This matter of volume of compressed air to be handled, which governs the time that must elapse between the application and release of the brakes on the extreme ends of the train, is recognized by air brake men to be the most difficult problem that is presented in brake operation under modern conditions, in fact, all of the difficulties encountered in operating brakes on very long freight trains and as well on exceptionally long passenger trains, are entirely due to the time element incident to the transmission of large volumes of compressed air.

We have frequently mentioned results of air brake tests which have demonstrated the uncertainty of application and release of brakes on 100 car trains and even with 12 car passenger trains of double equipments where the dominating factor is the large volume of the brake pipe and auxiliary reservoirs, and if this were otherwise an empty and load brake could be constructed by merely adding another triple valve and auxiliary with a brake cylinder and proportioning the leverage of the second cylinder as required, then the second brake could be cut out when the car is empty and cut in when loaded.

However, as the volume of the brake pipe is already practically excessive and the drain upon it during a release almost prohibitive, it follows that an empty and load brake must be operated without any material increase in the volumes already employed hence the brake in question is built upon this principle. The use of type K triple valves has in a large measure offset the effects of the exceedingly slow rate of drop in brake pipe pressure during an application of the brake by making local reductions of brake pipe pressure at each triple valve and the rate of increase in pressure during release has to a certain extent been augmented by the head triple valves absorbing less brake pipe pressure at the time of release, hence the features of this type of triple valve have been retained in the design of the K-L valve of the improved brake. The principal improvement, however, as already outlined, is the provision of an efficient brake for a heavily loaded car and it has been accomplished by adding a brake cylinder and using a new form of operating mechanism with a slight increase in the reservoir volume.

The triple valve and auxiliary reservoir of the standard equipment is replaced by a four compartment reservoir, a triple valve of a different type, a change over valve and added to the standard equipment is a "load" brake cylinder, its cylinder lever and connections and an operating mechanism. A new type of retaining valve is used but other details as to cut out cocks, hose couplings, dirt collectors, etc., remain unchanged. The large chamber of the four compartment reservoir is called the auxiliary reservoir, it is of 2,440 cubic inches capacity. The other three compartments are, a "load" reservoir of 550 cubic inches, a "take up" reservoir of 160, and a "reduction" reservoir of 550 cubic inches. The supply of compressed air for operating the "empty" cylinder is stored in the auxiliary or largest chamber and when the brake is in empty position which is used when the car is not loaded, the K triple valve shown (which is termed the K 2 L) operates the auxiliary reservoir and empty brake cylinder in the same manner as any ordinary K valve and the other reservoirs are not used until such

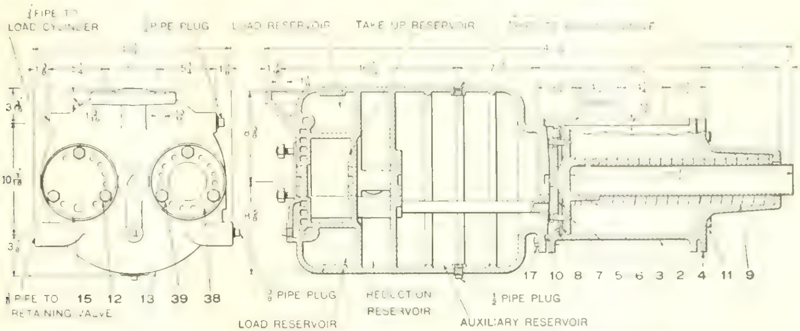


time as the car is loaded and the operating mechanism turned to load position.

The object of the "load" reservoir is to store a volume of air to be added to the auxiliary reservoir volume for the operation of the "load" brake cylinder. The object of the "take up" reservoir is to store an additional volume to produce an increased pressure in the "empty" brake cylinder when needed. The use of the "reduction" reservoir is to permit a drop the additional volume of compression necessary for the operation of the "load" cylinder can be stored in the small chambers referred to, adding but a trifle to the volume of compressed air expanded.

In order to maintain the proper amount of braking power per pound of brake pipe reduction it is necessary to use the single cylinder only, but at a high pressure, at the start of the application or during very light reductions, then change valve to be unseated by the increase in brake cylinder pressure which brings the "load" cylinder into operation and opens the passage to the "reduction" reservoir so that a temporary doubling of brake piston area also results in a momentary halving of pressure, and the braking power per pound of brake pipe reduction increases uniformly and in proportion to that of an empty car brake.

After this action which prevents any



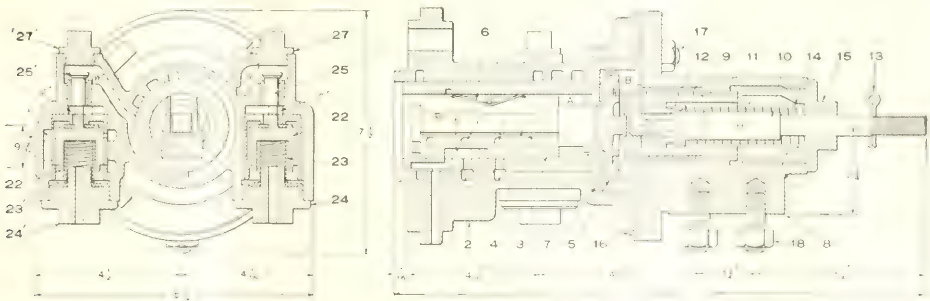
EMPTY BRAKE CYLINDER AND FOUR COMPARTMENT RESERVOIR

in brake cylinder pressure as required when the "load" cylinder is first brought into play.

When the car is loaded and the brake is turned into load position, the "empty" cylinder operates alone up to the time the use of the second or "load" cylinder becomes necessary. This time is predetermined and governed by the pressure obtained in the "empty" cylinder. to the use of two cylinders as necessary and temporarily lower the pressure as the change occurs, that is when the piston area is suddenly doubled it is necessary to temporarily halve the pressure.

Assuming an 8-inch piston travel of the "empty" cylinder, a 7-pound brake pipe reduction produces about 24 pounds cylinder pressure due to a flow from the auxiliary reservoir, from the "take up" unwarranted increase in braking power for the brake pipe reduction, further brake pipe reductions build up brake cylinder pressure on the load equipment at the same rate and with the same retarding effect that is obtained on the single cylindered car when it is empty.

With light brake pipe reductions, up to where the "load" cylinder comes into action, the brake cylinder pressure per



[illegible]

The push rod of the "load" cylinder is of square section with the upper side notched to receive a pawl, and the "empty" cylinder operating first, takes up the slack in the brake rigging and as the "load" cylinder cannot operate until the "empty" cylinder contains 24 pounds pressure the piston of the "load" cylinder travels but 1½ or 2 inches.

Due to this [illegible] travel reservoir and from the brake pipe through the quick service port of the triple valve to the "empty" brake cylinder. The same reduction on the empty position or on the standard equipment results in about 9 or 10 pounds cylinder pressure, so that this difference provides for the load and as 24 pounds is attained in the "empty" brake cylinder a continuation of the brake pipe reduction causes a spring loaded pound brake pipe reduction is 6.5 absolute pressure, and the braking power delivered per pound brake cylinder pressure is .342 per cent. When the load cylinder comes into action the brake cylinder pressure [illegible] from 6.5 absolute to 3.25 absolute and the per cent braking power per pound brake cylinder pressure changes from .342 to .8 per cent., thus in the first case the addi-

[illegible] braking power [illegible] the load is de[illegible] [illegible] pressure [illegible] the second [illegible].

The [illegible] as a general [illegible] of the [illegible] in future issues the triple valves and change-over valves will be shown in various positions in diagrammatic views so that those in[illegible] thoroughly understand the construction and operation of this brake.

Equipose in Accelerating and Retarding Force.

[illegible] description of the opera-tion of the empty and load brake it is desired to offer a brief resumé of the [illegible] that have [illegible] that

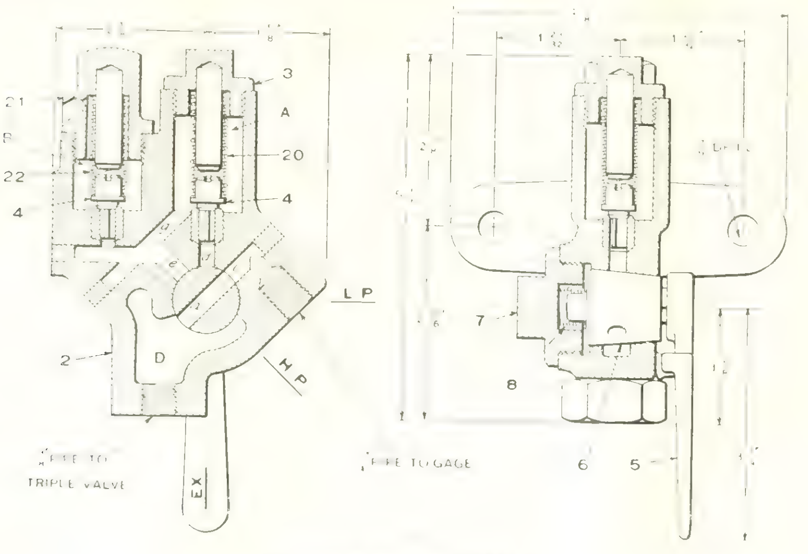
The work that a freight car brake is capable of doing in grade service is an uncertain quantity and it cannot always be assumed that the brakes, if in good condition, should hold the train regardless as to speed, load, or grade because of the actual fact that there are many [illegible] best of condition is inadequate to permit of the control of the train of loaded cars with the air brake alone.

In the consideration of the two forces [illegible] descend the grade, the other the braking effect tending to prevent the descent, it will be of interest to refer to the Air Brake Department of the November 1914 issue, which our readers should have re[illegible] will be observed

mile, one per cent. of the weight of the car would be exerted as force tending to descend the plane.

[illegible] a two per cent grade, or a descent of 105.6 feet in each mile traversed, the descending force would be two per cent. of the weight, hence the assumption that car weight X by per cent. of grade = accelerating force due to grade.

The opposing force set up by the application of the brake which acts to check the descent of the car, is measured by nominal percentage of braking power, coefficient of friction and brake rigging efficiency, and multiplying the first named factor by the second, and the product by the per cent. of brake rigging efficiency gives a figure which is the force of re[illegible] per cent. of the weight of



PRESSURE [illegible]

[illegible] the [illegible] descent of heavily loaded cars on mountain grades.

[illegible] braking force of the standard brake is limited to a per cent. of the light weight [illegible] against wheel sliding may be provided for at low rates of speed. This, however, makes no provision for an adequate braking power when the car is loaded, and while the added weight of the load cannot be correctly termed as unbraked weight, the percentage of braking power obtainable varies inversely with the increase in the weight of the load carried, or the heavier the load the lower the per [illegible]

that [illegible] braking power [illegible] on grade, where G = per cent. of grade, e = brake rigging efficiency, per cent., [illegible] coefficient of friction.

[illegible]

This is derived from an obviously correct assumption that a car on a grade is a rolling body on an inclined plane, and its weight or gravity is exerted in two directions, one force pressing against the surface of the plane and the other tending to produce motion down the plane, and as velocity and weight increase uniformly with the incline of the plane, on a one per cent. grade, where the in[illegible]

[illegible] pounds.

The recommended practice is the employment of a braking force for freight [illegible] that will [illegible] per cent. [illegible] light weight based on a 50-pound brake cylinder pressure, and air brake dem[illegible] efficient of friction obtained is not over 10 per cent., that is, the actual pull of the shoe on the wheel does not average over 10 per cent. of the pressure forcing the shoe against the wheel, and the loss encountered in transmitting the power developed by the brake cylinder to the brake shoes is but about an average of 5 per cent. in freight car brakes, therefore the brake rigging efficiency (for [illegible] per cent.

As an example, a 40,000-pound freight car loaded with 100,000 pounds weight, on a 2 per cent. grade the force exerted tending to descend is 140,000 x .02 = 2,800 pounds. The available retarding force is .60 x .10 x .95 = .057 and 40,000 x .057 = 2,280 pounds. Thus it becomes evident that the brake could not be expected to control such a total car weight on a 2 per cent. grade.

If it is desired to find the braking power required to control such a car, that is, to equal the accelerating force so that the car would neither increase or decrease in speed, an equation would appear as follows.

Accelerating force due to grade = retarding force due to braking power, or, car weight x per cent. of grade = car weight x braking power x efficiency of brake rigging x coefficient of friction.

Dropping the common multiplier, car weight, and transposing the equation leaves,

$$\text{Per cent. of braking power} = \frac{\text{Per cent. of grade}}{\text{Coefficient of friction x brake rigging efficiency.}}$$

$$\frac{.02}{.95 \times .10} = .21 \text{ or } 21 \text{ per cent.}$$

braking power will be required to equal the force exerted down the grade. As to the force available in per cent. of braking power, 60 per cent. of the 40,000-pound car is 24,000 pounds, or 24,000 pounds ÷ 40,000 = .60 but 24,000 ÷ 140,000 the total weight of car and load is but .17 or but 17 per cent. braking power can be obtained from a full service application of the brake where 21 per cent. is required to prevent an increase in the rate of speed.

Occasionally some reader will protest against an equation or a short cut in mathematics, and to prove the above in plain arithmetic is a very simple proposition by merely adding the car weight and performing the multiplication. Assuming a car weight of 40,000 pounds on a 2 per cent. grade,

$$\frac{40{,}000 \times .02}{40{,}000 \times .10 \times .95}$$

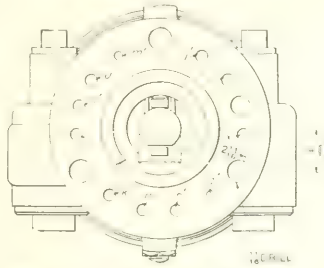
40,000 x .02 = 800 pounds.
40,000 x .10 x .95 = 3,800 pounds.
800 ÷ 3,800 = .21 or 21 per cent.

To prove the figures that 21 per cent. braking power is necessary to prevent an increase in speed.

40,000 x .02 = 800 lbs.
40,000 x .2105 = 8,420 lbs.
8,420 x .10 = 842 lbs.
842 x .95 = 800 lbs.

It is evident that the problem of controlling trains on long heavy grades is one of obtaining sufficient braking power in proportion to the total weight of the train and when the difference in weight of empty and loaded cars is as much as three or four times the weight of the empty car, the application of the standard brake is fundamentally wrong because the brake cannot provide the requisite retarding effect for the load, which may compose as much as 75 per cent. of the train weight. The solution of the problem demands that the load be considered as well as the car itself otherwise an adequate braking power for loaded cars cannot be obtained from air operated mechanism, but with the empty and load brake, the load cylinder leverage is arranged to bring the total braking power up to 40 per cent. of the weight of the car and maximum load, then with the car of 40,000 pounds weight and a load of 100,000 pounds, on a 2 per cent. grade, 40 per cent. braking power instead of 17 per cent. will be available.

Now the term per cent. or percentage of braking power, when used among air brake men, is understood to represent the value of the brake cylinder in pounds of force developed multiplied by the total leverage of the foundation brake gear as compared with the light weight of the car, but from a viewpoint of retarding force obtained between the brake shoe and the wheel, it is a meaningless term expressing absolutely nothing. The actual pull of the shoe on the wheel tending to check the rotation is termed the coefficient of friction which is a per cent. of the force pressing the shoe against the wheel. The coefficient of adhesion is a force obtained between the wheel and the rail which must be broken or exceeded by the retarding effect between the shoe and the wheel before wheel sliding will occur, [illegible] the weight resting on the wheel.


END VIEW OF CHANGE OVER SWITCH

The reason for employing a low calculated braking power, such as 60 per cent. based on a 50-pound brake cylinder pressure, in freight service is because of the low average rate of speed of freight car trains, and if the reader can refer back to the March 1913 issue, there will be found a number of tables taken from the Westinghouse-Galton brake tests which will very clearly indicate why a higher calculated braking force is not permissible for low speeds.

[illegible] the table [illegible] total [illegible] total weight on braked wheels, it will be seen that where the coefficient of adhesion happens to be as low as 15 per cent., a brake shoe pressure of but 70 per cent. of the weight resting on the wheel would be required to slide the wheel at a speed of 15 miles per hour. Under ordinary conditions this holding power or coefficient of adhesion ranges from 15 to 30 per cent. of the weight of the wheel on the rail and varies only with the condition of the rail or the surfaces in contact. The use of sand or similar substance would increase the percentage of adhesion while the use of a lubricant would lower it, but the average coefficient of adhesion is from 20 per cent. to 25 per cent. of the weight pressing the wheel to the rail.

Further down in the column of this table it will be seen that under the same figure of adhesion, at a speed of 30 miles per hour, a brake shoe pressure of but 92 per cent. of the weight on the wheel would equal the force necessary to slide the wheel.

This, however, should not be confused with the design of brakes for high speed passenger service where an efficient brake must be provided for an average or good condition of rail, because if the coefficient of adhesion is as low as 20 per cent. a brake shoe pressure of 2.77 times the weight on the wheel is required to slide a wheel at a speed of 60 miles per hour.

The tables also show the coefficients of friction obtained from various rates of speed, but as an example, if we should take the 40,000-pound car referred to, 5,000 pounds will be the weight resting on each wheel and with a coefficient of adhesion of 20 per cent., when the periphery of the wheel reaches a speed of 60 miles per hour, the brake shoe pressure necessary to slide the wheel is 5,000 pounds x 2.77 or 13,580 pounds. Under the assumed condition the adhesion of the wheel to the rail is 20 per cent. of 5,000 pounds and 1,000 ÷ 13,850 = .072 the coefficient of friction at 60 miles per hour.

From this it will be noted that the braking power necessary to slide a wheel at 60 miles per hour is not 60, 90, or 130 per cent., but 2.77 times 100 per cent. or 277 per cent., and if the adhesion is as high as 25 per cent., 347 per cent. brak- [illegible]

From these figures we may conclude that Mr. Turner was well within his province when he made the statement that the brake cylinder pressure neces- [illegible] [illegible] speed has never as yet been developed on the modern heavy car, and it may be relied upon that the conclusion that he arrived at, coming from one so eminently qualified, may be absolutely taken for granted to be correct.

Electrical Department

Economy in Using Electricity for Actuating Brakes
Introduction of the Automatic Flagman

The Economic Value of Using Electricity for Actuating Compressed Air Brakes.

[illegible]

[illegible] apply solely to passenger traffic, and chiefly to that of electric traction.

[illegible] employing electricity as motive power for railroads lies largely in its convenience, economy of power from the use of large power generating units and the practicability of making, if desired, each car a power vehicle, which of course means lighter road-bed construction and so forth. The economy and advantage of electricity as motive power under certain favorable conditions cannot be questioned. [illegible] New York City certainly need no further evidence of this. It does not necessarily follow, however, from the convenience and flexibility of electric motive power that the capacity of a road is increased thereby, although it makes practical many things which very greatly increase the capacity in indirect ways, which plainly is as valuable as though it were direct. Anything is valuable to a railroad, other things being equal, that save time, since this is the only purpose or service of a railroad. However, setting trains in motion is no more necessary to railroad operation or increase of capacity than again bringing them to rest. In fact the more adequate the provision for doing the latter the better the purpose of a railroad is served, since then high speed and frequent trains are practical and safe. Time saved during deceleration is just as valuable as time saved during the acceleration. A train may possess substantially the same energy that was put into it from the power-plant during the acceleration, at the time braking is commenced. Plainly this energy can be dis- [illegible] shorter the time the nearer one comes to getting double value from the power [illegible] Thus anything which contributes to this end is worthy of consideration, and be- [illegible] tion to a comparatively new use to which electricity is being put, that is, as a means for actuating the air valves of the compressed air brake. The wonder is that this has been so long in coming to pass. [illegible] onstrable to say that the capacity of a railroad can be doubled if full advantage, directly and indirectly, is taken of its use.

Of course this statement means where the capacity is otherwise taxed; that is, where there is sufficient traffic to require the increase.

At first thought it may appear that the only thing gained is the elimination of the time lapse between the brake valve manipulation and the movement of the brakes throughout the train, but this is not the only thing by any means; on the contrary, it is the least factor in the net result, though it makes possible all the advantages that accrue or that may be obtained. To illustrate, with the brake actuated electrically the rail limits the retardation that can be developed, whereas without it the train itself limits the retardation. One cannot set up strictly pneumatically a rate of retardation anywhere near approaching the capacity of the rail since it would cause such a severe shock between the front and rear of the train as to be not only prohibitive but disastrous. For example, the time lapse between the brake application front and rear is such that it permits of the maximum retardation being obtained at the front of the train before any retardation results at the rear, which means that if a retardation were *set up* at the front end of an 8-car train at a greater rate than $3\frac{1}{2}$ per cent. per second, such severe shocks would result as would damage the car equipment and be injurious to passengers; while with electrically actuated brakes it is possible to *set up* at least ten times this rate without damage or inconvenience. In addi- [illegible] which the initial retardation can be developed, it is also practicable to let the maximum retardation approach very closely to the holding power of the rail, which we may take as 25 per cent. of the vehicle weight.

It is evident that the necessity of lim- [illegible] tardation is being developed at the front end, and (2) the maximum retardation to be employed, results in a pneumatic brake of low efficiency compared to an electro-pneumatic brake, the same relative freedom from shock being obtained in each case. A pneumatic brake should not set up a retardation at the front of the train greater than $3\frac{1}{2}$ per cent. per second at a speed of 10 m. p. h. if shocks are to be eliminated. Such a retardation is set up when 60 lbs. cylinder pressure is secured in 6.6 secs., the braking ratio then being 120 per cent. At 40 m. p. h. such a brake would stop a train in 580 ft. With an electro-pneumatic brake on the other hand, 100 lbs. cylinder pressure can be obtained in 2 secs., giving 150 per cent. braking ratio. This brake would stop a train from 40 m. p. h. in 330 ft. Thus, compared on the basis of relative freedom from shock with an 8-car train, the stop with the pneumatic brake at 40 m. p. h. would be 580 ft., and with the electro-pneumatic 330 ft. Moreover, the stop with the pneumatic brake will increase with the length of train, while that with the electro-pneumatic brake is independent of train length.

It can also be seen that with a pneumatic brake the train length is limited thereby, but with an electro-pneumatic brake trains of any length are feasible insofar as the brake is concerned. The rate of retardation which it is possible to set up at the front end of a train with a pneumatic brake is dependent upon the length of train. That is, the greater the time lapse between the brake application of the first and last car, the greater the shock with the same rate of retardation both because of the greater time during which the first car is being retarded and the higher value of the retardation during this period. It is necessary, then, either to vary the rate of retardation and the maximum obtained, with the train length, or to limit the train length to correspond to the rate of which the retardation is set up. The choice is confined consequently either to a brake of low efficiency or to short trains, or to shocks. Such limitations do not exist when the brakes are actuated electrically. For service applications at least 5 seconds can be saved for every stop from 40 m. p. h., while for emergency stops such a high braking ratio can be employed as to cut the stopping distance practically in half when anywhere near equal freedom from shocks is considered, and even better than this can be done if braking according to car weight, loaded or unloaded, is employed, which the use of electricity makes possible and practical. From the foregoing it should be apparent how valuable electrical brake actuation is to the railroads, considering economy, efficiency and capacity.

The consideration then of the use of electricity for the transmission of brake action may be viewed from two broad standpoints, namely:

(1) For obtaining simultaneous brake action throughout the train which insures comparative uniformity of retarda-

tion throughout the train with consequent smooth handling and reduction in shocks and stresses in the [illegible] and of course this will apply [illegible] application and the release of the brakes. When the electric attachments are applied for this purpose, any shortening of the stop is purely incidental to the main purpose for obviously the attachments may be applied to a brake of a very low order of efficiency—that is to say if the shortening of the stop is the desideratum, it can be made much shorter by the improvement of the pneumatic brake itself than by merely adding the electric attachments to a pneumatic [illegible] of low efficiency.

(2) For not only the above mentioned purpose, but also to make permissible, i. e., practicable, a much more powerful and efficient pneumatic brake for the purpose of shortening the stop than otherwise could be employed.

The time element necessarily elapsing between the brake application at the front and rear ends of the train practically prohibits the employment of the most efficient purely pneumatic brake, since if maximum braking power in the highest practical degree is obtained as quickly as air brake mechanism can be made to deliver air from the reservoir to the brake cylinder, such a high rate of retardation is instantly set up at the head end of the train that the rear end runs into it with the force of a collision, varying in intensity proportional to the difference between the velocity of the two ends; the severity also being according to the masses.

For example, with a brake electrically actuated, it is permissible on a train of say twelve heavy cars to set up a retardation at the rate of 30 per cent. per second, while very severe shocks would be had with the same train if a rate of 5 per cent. was obtained suddenly at the head end without electric transmission, or, to put it another way, 100 lbs. cylinder pressure obtained in two seconds or less will not produce shocks or wheel sliding on such a train if the action is transmitted electrically, whereas, if transmitted pneumatically very severe shocks, and probably wheel sliding would occur, if other things being equal—the cylinder pressure were obtained in less than four times this time.

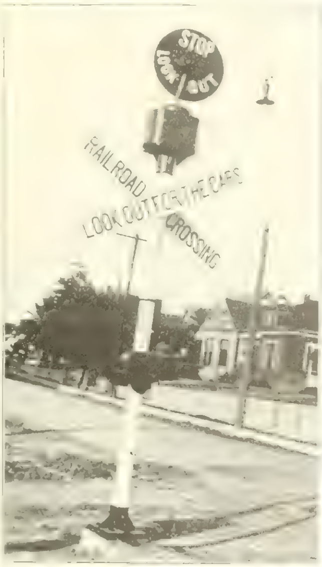
The capacity or pull of the rail is the measure of the retardation that can be developed when electric transmission is employed, while, without it, the difference in quantity and rate of retardation which can be tolerated between the front and rear of the train on shock account must be the measure, which obviously with a pneumatic brake will vary with the different lengths and weights and make-up of trains, as well as speeds.

Electric transmission will greatly increase the safety, capacity and economy of a railroad, particularly where a high density of traffic exists.

From the foregoing it will [illegible] that the electric attachments are chiefly valuable in that they eliminate the time element, which (1) materially reduces the probability for rough handling of trains, and (2) in addition, makes it practicable to develop retarding force much more rapidly throughout the train both for service and emergency application, and (3) in addition to employ a much higher factor of retardation than is practicable without it, and (4) does away with the limit a pneumatic brake sets upon train length. What this new use for electricity on railroads consequently means to the railroads in the way of increased capacity, convenience and economy of operation, etc., is so apparent, so clear and distinct, that comment is superfluous.

The Automatic Flagman.

At the present day with the large number of automobilists journeying throughout the rural and country sections, the liability of accidents at grade crossings is greatly increased. The old "Stop Look and Listen" signs are not conspicuous enough even in the day time for the rapidly moving motorists, and at night are practically of no benefit.



THE AUTOMATIC FLAGMAN.

The [illegible] Los Angeles are manufacturing a device called the "Automatic Flagman," to protect the railway crossings by giving positive and effective warnings as the trains approach.

The illustration shows one of these devices. As the train approaches the disc at the top, which is painted a bright red, is waved and a loud gong is rung, the energy being supplied by a small electric motor. In the centre of the disc is a red lens illuminated at night by a light so that the "Flagman" is as effective at night time as in the day time.

When used with steam railroads a storage battery supplies the power for the electric motor, and when used with an electric road, power can be taken directly from the trolley wire. The track is blocked off, and whenever a train enters the block power is connected to the motor, which is cut off when the train has passed by the crossing and out of the block. Several hundred of these "Automatic Flagman" are installed on the Pacific Electric Railway, and some operate as many as 300 times a day.

Special Electric Equipment.

As an example of the hearty spirit of co-operation with which the operating companies are working with the Public Service Commissions, the recent orders placed by a number of companies operating throughout Illinois for measuring instruments are of particular interest. These companies in complying with the orders of the Illinois State Utilities Commission have ordered for use in regular portable service high grade meters such as are used in standard laboratory work.

The Illinois Traction System has placed an order with the Westinghouse Electric & Manufacturing Company for nineteen type U graphic voltmeters, twenty portable standard watthour meters, nineteen portable voltmeters, together with a number of other miscellaneous portable instruments of the laboratory type.

The Southern Illinois Light & Power Company, Hillsborough, Ill., has also ordered eight portable graphic voltmeters and two ammeters of the same type, four portable wattmeters, two portable voltmeters and ammeters, two portable current transformers, and two each of the switchboard type graphic voltmeters and voltmeters, together with a varied assortment of other types of laboratory instruments. Such a liberal interpretation of the orders of a public utility commission as shown by these two companies cannot fail to win public approbation.

Electric Equipment.

The Chicago & Milwaukee Electric Railroad Company have placed an order with the Westinghouse Electric & Manufacturing Company for fifteen quadruple equipments of type No. 557-A, 140 hp motors with double end type "HLF" control. These equipments are to be placed in high speed passenger express service between Chicago and Milwaukee. The cars will be arranged for train operation.

Tour of the Sunny South

By ANGUS SINCLAIR

[illegible] a person [illegible] on a [illegible] station in good season and asking the station master when the next train for Washington would arrive.

"Which day's train do you want?" inquired the agent.

[illegible] THROUGH THE ORANGE GROVES OF FLORIDA

"Today's train, of course," was the reply.

"Well, it will come along bye and bye," was the information given.

Shortly afterwards a train arrived and the passenger made a rush to get on board when he was stopped by the agent shouting: "That is not your train."

When the train had gone, the would-be passenger wanted to know what train that was.

"Why," replied the station master, "that was yesterday's train, and you said that you wanted to take this day's train."

That was the kind of story he told about the old-time railway habits of the [illegible] days.

The cold winds of New York make me "tremble and shiver," as Hood says, "and of late years I have run away from them and taken refuge in the Sunny South, with Florida as a lingering place. It turned out this year that the weather of March in our resort of comfort was as strenuous as it was in New Jersey, but that was our misfortune, not our blame. The tour made in search of warmth is worthy of mention, for it gives an idea of how far-reaching is new railway facilities in the Southern States.

Starting from New York, we rode upon the Erie Railroad to Cincinnati, a railroad system 2,200 miles in extent, operated by 1,465 locomotives and 55,160 cars. At Cincinnati we took the Queen & Crescent line, which is a system over 1,200 miles long, operating [illegible] 15,000 cars [illegible] 300 locomotives. We did not finish our journey on that line, but changed to the Southern Railway at Chattanooga, which took us to Jacksonville, Fla. [illegible] journey from Cincinnati to Jacksonville may be regarded as the territory between the temperate and the hot regions; but it must be wonderfully alluring to persons who enjoy climate that is neither too hot nor too cold. The States of Kentucky, Tennessee, Alabama and Florida traversed, form garden spots for enterprising agriculture, having immense possibilities of production that are not yet realized, but will be in the near future.

The Queen & Crescent and its connections run splendid trains for the accommodation of southbound visitors, and I may also remark as an answer to the jibe of my opening paragraphs, that the punctuality of the trains was admirable. In a tour of 4,000 miles, I found all the trains practically on time with unusually clean cars and respectful service.

Another thing about Southern railways is worthy of remark—the extent of their mileage and the sentiment of the various communities in favor of all the extension required for the business to be carried. One hears of no political demagogues abusing railway interests, howling in favor of action that means confiscation, and villifying the property that has made their farms, homes, villages and towns what they are, expressions that are heard so frequently in what was known as the Granger States.

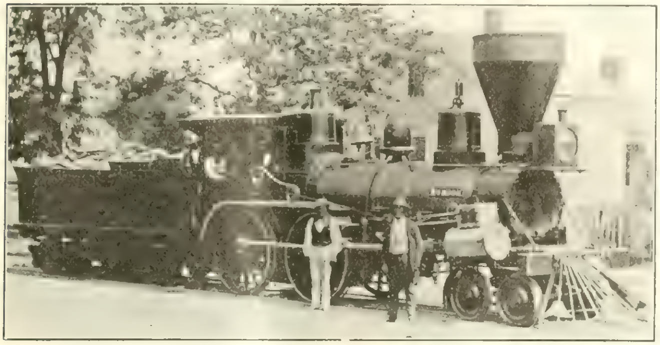
Good railway facilities did not always exist in Florida even up to comparatively recent years. About 1883 Mr. Henry M. Flagler, a well-known capitalist, went to Florida in quest of health and recreation. While sojourning on the east coast he became impressed with the possibilities of that region as health resorts and for the development of agriculture and fruit raising. He resided in St. Augustine for a time, and was earnestly impressed with the genial climate and other attractions. That place was then reached by two very inferior narrow gauge railroads which Mr. Flagler bought and converted into first-class standard lines. From this humble beginning a noble series of railroad tracks was gradually pushed southward, until now it extends from Jacksonville to Key West, 694 miles. The system is operated by 124 first-class locomotives and 1,667 cars.

[illegible] KEY, FLA.

Key West, which is known as the Gibraltar of America, was aimed at because of its fine climate and valuable Cuban trade; but to reach the place involved immense engineering operations. When the idea of extending the East Coast Railway to Key West first occurred to Mr. Flagler, he consulted one of the

most accomplished engineers on the continent concerning the obstacles to be overcome. The estimate made of the expense of the enterprise was immense, but on studying the figures Mr. Flagler said "go ahead," and there the discussion ended.

The principal part of the enterprise was



TYPICAL WOOD BURNING LOCOMOTIVE

the construction of a railway 114 miles over sea-swept coral islets. Special machinery was designed for the work and it was carried out very expeditiously. Between the mainland and Key West the greater portion of the islets were found so close together that the sea stretches were never long. Between some of the islets the water was found to be so shallow as to enable an earthen embankment to be constructed. But at some places a water gap would be found very wide and deep, demanding trestling, masonry viaducts and steel bridges. Fortunately the engineer was spared a tedious search for suitable foundation which is invariably associated with sub-aqueous work, because the sea bed in that region is formed of hard coral rock.

The Key West extension of the Florida East Coast Railway is one of the greatest engineering enterprises the world has ever seen, and forms a most substantial monument to the fame of its promoter.

Another enterprising financier who conferred enduring benefits upon Florida was Morton F. Plant, who displayed much enlightened liberality in promoting railway enterprises, and did much towards making the transportation facilities of that State second to none.

All the Southern States are unusually well provided with railway facilities, a fact due in a great measure to the fair sentiment of the people towards this line of enterprise. Our rambles took us for many miles over the Southern Railway, which possesses 7,042 miles of track, operating 52,600 cars by 1,690 locomotives. Florida is a great peninsula formed by sand, mostly of a submarine character, white as snow. The sand is different from that usually blown out of the ocean, which has a basis of silicon. This Florida sand has been formed from marine shells and has a basis of calcium or limestone. When this sand is fertilized it produces good crops of various kinds which give the country a fertile appearance.

Of course, the Southern States are indebted to railways for a great part of the prosperity they enjoy. In the last twenty-four years the railways of the South have expanded 93 per cent. This increase alone is equivalent to the entire railroad mileage of the United States at the close of the Civil war. This has called for hundreds of millions of new money being brought into and expended in the South for construction of the means of intercommunication. The direct expenditure of money represents only a part of the benefits distributed. The railway industries have been spending and distributing approximately $1,500,000 a week in wages, giving employment to 167,000 men and supporting at least 750,000 people.

Assuming that land for ten miles on each side of the 33,500 miles of new railroad has been enhanced to the value of only $5 an acre, this increase, due solely to the introduction of improved transportation facilities, amounts to over $2,000,000,000. This extension of railroads meant the rehabilitation of idle farms and the development of new ones, the exportation of mineral deposits, the construction of mills, factories, furnaces and other industries, which is rapidly converting the South from purely agricultural to mixed industrial communities.

Another far-reaching Southern Railway system which carried us many miles was the Seaboard Air Line, extending its track 3,100 miles, operating 18,550 cars by 520 locomotives. Of the equipment and punctuality of trains I can only say that it was equal to the best lines of the South.

In traveling over Southern railways people are frequently struck with the close connection sometimes maintained between things that are ancient and modern practices. A great portion of the railroad mileage was originally operated by wood-burning locomotives, and wood in some parts is still so abundant that it is still used as locomotive fuel. So the locomotives with their huge smoke-stacks are still to be seen in some places mixed with engines of the latest patterns. As many of our readers are no longer familiar with the wood burner of long ago, a typical wood burning locomotive is shown as an illustration of the kind of locomotives that hauled the trains on most American railroads North and South during the greater part of the last century, and quite a large number are still doing excellent service in the Sunny South, and bid fair to endure for many years to come, in the lighter kind of service.

VIEW OF TRACK ON THE [illegible] EXTENSION, FLORIDA.

Items of Personal Interest

Mr. [illegible] Butler has been appointed [illegible] office at [illegible].

Mr. [illegible] has been appointed [illegible] of the Canadian Northern, with [illegible].

Mr. [illegible] Stewart has been appointed [illegible] of the Grand Trunk, with [illegible].

Mr. W. G. Hall has been appointed general foreman of the International & Great Northern, with office at Palestine, Tex.

Mr. R. R. [illegible] has been appointed general foreman of the [illegible] of the Tennessee Central, with office at Nashville, Tenn.

Mr. [illegible] has been appointed general foreman of the car department of the New York Central, with office at [illegible].

Mr. [illegible] has been appointed general foreman of the Texas Midland, with office at Terrell, Tex., succeeding Mr. [illegible] Miller.

Mr. J. W. Marshall has been appointed [illegible] foreman of the Canadian Pacific, with office at [illegible], Man., succeeding Mr. [illegible].

Mr. [illegible] Miller has been appointed [illegible] of the Canadian Northern, with office at Toronto, Ont., succeeding Mr. [illegible].

Mr. [illegible] of the [illegible] of the Grand Trunk, [illegible] transferred from Port [illegible].

Mr. [illegible] has been appointed [illegible] of the St. Louis [illegible], with office at [illegible].

Mr. W. H. [illegible] has been appointed [illegible].

[illegible]

[illegible] master mechanic of the Missouri, Kansas [illegible] in place of Mr. N. S. Airhart, resigned.

Mr. Charles D. Wilder has been appointed [illegible] with office at Clifton, Staten Island, N. Y.

[illegible]

[illegible] of the Chicago Railway Supply Company, Chicago, has [illegible] selling force of the National [illegible] Company, Cleveland, O.

Mr. A. [illegible], who has been [illegible] manager of the Hewitt Co., at Maywood, Ill., has been appointed to the new position of [illegible] engineer for the same company.

Mr. [illegible], formerly signal engineer of the Rock Island Lines, has opened an office in the Transportation Building, Chicago, as consulting electrical and signal engineer.

Mr. A. [illegible] has been appointed locomotive foreman of the Grand Trunk, with office at [illegible], Que., succeeding Mr. G. [illegible], who has been placed on the retired list.

Mr. Sheridan [illegible] has been appointed fuel supervisor of the Boston & Maine, with headquarters at Boston, Mass. He will have charge of all matters pertaining to the use of fuel.

Mr. Joseph Miller has been appointed assistant engineer of the Cleveland, Cincinnati, Chicago & St. Louis, and will have charge of special investigations, with office at Cincinnati, Ohio.

Mr. [illegible], formerly superintendent of motive power of the Seaboard Air Line, has become associated with the Galena Signal Oil Company, with headquarters in Atlanta, Ga.

Mr. A. [illegible] Powell, formerly master mechanic of the Western Pacific, with office at Sacramento, Cal., has been promoted to the position of general master mechanic at the same place.

Mr. W. [illegible], formerly superintendent of motive power of the Eastern lines of the Canadian Pacific at Montreal, Que., has been appointed electrical engineer of the same road.

Mr. [illegible] has been appointed general foreman of the locomotive department of the [illegible], with office at [illegible], succeeding Mr. [illegible], promoted.

Mr. [illegible] of the [illegible] of the Grand Trunk at Montreal has been transferred to a similar position on the same road with office at [illegible].

Mr. J. L. Hodgson, car foreman of the Canadian Northern at Joliette, Que., has been transferred to a similar position on the same road at [illegible], succeeding Mr. R. Moore, assigned to other duties.

[illegible] ill health.

Mr. M. A. Sherritt, manager of the Philadelphia branch of Manning, Maxwell & Moore, Inc., New York, has resigned to accept the position of vice-president and general manager of the Sherritt & Stoer Co., of Philadelphia, Pa.

Mr. A. B. Cartwright, formerly acting assistant engineer of the Seaboard Air Line at Jacksonville, Fla., has been appointed assistant engineer, with office at Jacksonville, in place of Mr. L. K. Hoyt, assigned to other duties.

Mr. P. F. McManus, formerly superintendent of the Joliet division of the Elgin, Joliet & Eastern, has been appointed general superintendent, with office at Joliet, Ill., and the former office held by him has been abolished.

Mr. George A. Butler has been appointed acting assistant engineer of the Belleville division of the Grand Trunk, with office at Belleville, Ont., succeeding Mr. C. S. Ogilvie, who has joined the Canadian forces for service abroad.

Mr. M. J. Scott, formerly master mechanic of the Canadian Pacific at Moose Jaw, Sask., has been appointed master mechanic of the Alberta division of the same road, with office at Calgary, Alta., succeeding Mr. A. Sturrock, promoted.

Mr. H. H. Vaughan, formerly assistant to the vice-president of the Canadian Pacific, has resigned in order that he may devote his attention to contract engagements that he is interested in. His services as consulting engineer are retained.

Mr. Alexander Taylor has been promoted to secretary of the Lake Superior Corporation, the Algoma Steel Corporation and subsidiary companies, succeeding Thomas Gibson, who recently became president of the Lake Superior Corporation.

Mr. W. [illegible] has been appointed superintendent of the Toledo division of the New York Central Lines, succeeding Mr. [illegible] B. Cook, deceased, and Mr. [illegible] K. [illegible] has been appointed superintendent of the Detroit division of the same road, succeeding Mr. [illegible].

Mr. [illegible], formerly signal engineer of the Toledo & Ohio Central and the Zanesville & Western, has been appointed superintendent of telegraph and signals of the same roads, retaining jurisdiction over the signal departments, with headquarters at Columbus, Ohio.

Mr. Samuel [illegible] has been appointed chief mechanical engineer of the Philadelphia & Reading, with offices at Philadelphia, Pa. Mr. [illegible] [illegible] the service [illegible] Philadelphia & Reading in 1902 as [illegible] engaged in

the extensive construction work in Philadelphia and vicinity.

Mr. J. J. Hamilton, in charge of the advertising and specialty department of

WILLIAM C. EDES.

the National Tube Co., has returned from an extended business trip to the Pacific coast in connection with the exhibit at the Panama-Pacific Exposition. The National Tube Co. exhibit is part of the United States Steel Corporation exhibit, which is located in the Mines and Metallurgy Building and occupies 44,000 square feet—the largest single exhibit at the exposition.

Mr. C. H. Buell, who has been appointed staff registrar and secretary of the pension fund on the Canadian Pacific, at Montreal, is from Jacksonville, Ill., and was employed by the Canadian Pacific in 1885, since when he has been in 1896 secretary to general passenger agent; October 1, 1896, to July 1, 1899, secretary to passenger traffic manager; July 1, 1899, to September 1, 1900, clerk to assistant general manager; September 1, 1900, to August 1, 1901, clerk to second vice-president and general manager; August 1, 1901, to November 1, 1906, chief clerk to assistant to the vice-president; November 1, 1906, to March 1, 1907, clerk to Vice-President McNicoll; March 1, 1907, to November 27, 1914, chief clerk to Vice-President McNicoll.

Mr. William C. Edes, who has been appointed by President Wilson as chairman of the Alaskan Engineering Commission, is a native of Bolton, Mass., and a graduate of the Massachusetts Institute of Technology, and entered railway service in 1878 on engineering work on the Southern Pacific. In 1886 he was assistant engineer of location and construction on the same road, and remained in the employ of the company for ten years. In 1896 he was appointed assistant engineer of the [illegible] San Joaquin Valley. In 1901 he was appointed assistant engineer of the Southern Pacific. In 1907 his duties were extended to include chief engineer of the Northwestern Pacific, and was engaged in some particularly difficult railway construction in the mountainous districts.

Lieutenant Frederick Mears, appointed a member of the Alaskan Engineering Commission, by President Wilson is from Nebraska, and entered railway service on the Great Northern in 1897. As assistant engineer he was engaged in locating lines in Idaho and British Columbia. In 1899 he saw active service in the Philippines, and in 1901 was appointed second lieutenant, and in 1905 graduated from the staff college at Fort Leavenworth, Kansas. In 1906 he was sent to the Canal Zone as assistant engineer and placed in charge of relocation of the Panama Railroad. He was successively resident engineer at Panama, engineer of construction, and latterly chief engineer. He had charge of the construction and maintenance of the relocated high level line of the Panama Railroad, and in 1913 he was appointed general superintendent in charge of operation, maintenance and construction.

Mr. Thomas Riggs, Jr., appointed by President Wilson as a member of the Alaskan Engineering Commission, is from Maryland. He studied civil engineering in the Princeton University, and was engaged for several years in the lumber business with the Seaco Manufacturing Company at Bucoda, Wash., and was also engaged in mining enterprises in the Klondike country. In 1902 he was further interested in mining operations in Utah, and in 1903 he was appointed a member of the United States Govern-

LIEUT. FREDERICK MEARS.

ment boundary survey board in connection with the Canadian boundary survey. After acting as surveyor for some time, he was, in 19[illegible] [illegible] surveying party. In 1906 he was transferred to the Alaskan boundary survey and remained on that work until 1910,

THOMAS RIGGS, JR.

when he was appointed engineer to the Alaskan boundary survey commission, in charge of all operations from the Pacific to the Arctic oceans.

HONOR TO DR. SINCLAIR.

Editor of Railway and Locomotive Engineering Appointed a Member of the Jury of Awards of the Panama-Pacific Exposition.

The president of the Panama Pacific Exposition at San Francisco, Cal., has appointed Dr. Angus Sinclair, New York, a member of the Jury of Awards in the Department of Transportation, and he enters upon his duties in the first week in May.

Dr. Sinclair's appointment meets with the hearty approval of the leading railway men in New York and vicinity. His long and close study of the details of the mechanical appliances used on railways eminently qualifies him for the position on the Jury of Awards, and it is to be hoped that his associate judges will bring a degree of experience to their duties worthy of the confidence reposed in them, and the awards may be relied upon as being as near perfection as can be made. At our going to press the complete list of jurors are not yet announced, but the list and the exact nature of their work will be published in a future issue of Railway and Locomotive Engineering.

The Bird-Archer Company, 90 West street, New York, manufacturer of boiler chemicals, has opened a St. Louis office at 513 Frisco Building, and a Chicago office at 860 Peoples Gas Building. The St. Louis office is in charge of Mr. J. A. McFarland, vice-president, and the Chicago office is in charge of Mr. L. F. Wilson,

Wireless New Records.

A new [illegible] wireless telephone was established on April 26, when Mr. [illegible] superintendent of the Scranton division of the Lackawanna, spoke from Scranton, Pa., to Mr. Frank Cuzek, superintendent of the Syracuse division, who was in Binghamton, N. Y. The message traversed sixty-three miles through a mountainous country.

The achievement was made more notable by the fact that the messages exchanged were not brief greetings, but business communications regarding the movement of trains. The Lackawanna trains between Scranton and Binghamton moved for several hours according to orders sent and received by the wireless telephone.

Every word transmitted by the wireless was heard distinctly, according to Mr. L. B. Foley, superintendent of telephone, telegraph and wireless of the Lackawanna, who was in charge of the experiment. Mr. Foley was jubilant over the achievement. Experiments with wireless telegraph and telephone have been conducted by the Lackawanna under his direction for more than a year.

The more recently recorded demonstration previous to yesterday's, was on February 9 last, when wireless telephone conversations were carried on between the station at Binghamton and a moving train at Lounsberry, N. Y., twenty-six miles away. The immediate object of the Lackawanna's experimenters now is to increase the distance between a fixed station and a moving train to fifty miles, and that between two fixed stations to 150 miles, the distance between Hoboken and Scranton

National Supply and Service Exhibition.

A mammoth national railroad supply and service exhibition will be held in the New Grand Central Palace, New York, on May 17 to 22, 1915, inclusive. The exhibition will be under the direction, management and supervision of the Order of Railroad Telegraphers, Despatchers and Signalmen of North America. The idea is to show the tremendous and wonderful progress made by inventors [illegible] every known contrivance that the human [illegible] guard the traveling public and the railroad servants in life and health, and against danger upon the great railroad systems. It will afford a striking proof that the men engaged in this great public [illegible] cerned in the proper safeguarding as the [illegible] will be delivered by notable public men and by a number of the leading railroad men of America. Communications in regard to space and other particulars should be addressed to Mr. Jacob Twzelar, Secretary, 621 Beekman street, New York City.

American Railway Tool Foremen's Association Convention.

The annual convention of the American Railway Tool Foremen's Association will be held at the Sherman Hotel, Chicago, Ill., beginning July 19, 1915, and continuing during the 20th and 21st. The topics to be discussed and on which committees will present reports embrace the following subjects: (1) Special jigs and devices in locomotive repair shops. (2) Safety first in regard to machinery and tools. (3) Maintenance of pneumatic tools. Special tools and equipment for same. (4) Grinding and distribution of machine tools in locomotive repair shops. (5) Standardization of reamers for locomotive repair shops. (6) To select an emblem for the association. The Supply Association as formerly are making elaborate arrangements for a display of supplies in relation to the work of the association that bids fair to surpass the exhibits of previous years, and an interesting convention and fine exhibition of materials may be expected. Mr. C. C. Schumaker is secretary and treasurer of the Supply Association and will gladly furnish details regarding exhibits. Address, 560 West Washington Boulevard, Chicago, Ill.

Reorganization of the U. S. L. Company.

A complete reorganization of The United States Light & Heating Company is now assured through the efforts of the stockholders' protective committee. It appears that the latter represent over $2,000,000 of the $2,500,000 outstanding preferred stock, and about $6,000,000 common stock, giving them the majority control.

The mammoth plant at Niagara Falls has been doing a larger volume of business during the present month than for a year past, and orders booked for future deliveries are considered satisfactory. With the future of the company now assured there will be a larger increase of orders that have been pending for some time on account of the uncertainty in connection with the destinies of the company, which are now happily settled, and which will result in the continued employment of a large body of men. As is usual in similar cases, the receivers will be authorized to sell the assets of the company, and, as stated before, the stockholders reorganization committee will [illegible] ors and the preferred and common stockholders whom they represent.

Annual Meeting of the Joseph Dixon Crucible Company.

The annual meeting of the stockholders of the Joseph Dixon Crucible Company, was held at the company's office in Jersey City on Monday, April 19, 1915. There were present a large attendance of stockholders who expressed their satisfaction with the present management and re-elected the former Board of Directors for the ensuing year. The vote recorded was the largest ever represented at an annual election—19,519 shares out of a possible 20,000.

The following named gentlemen are the directors elected: George T. Smith, Robert E. Jennings, George E. Long, E. L. Young, William G. Bumsted, J. H. Schermerhorn, Harry Dailey.

The officers elected by the Board of Directors are: President, George T. Smith; vice-president, George E. Long; treasurer, J. H. Schermerhorn; secretary, Harry Dailey; assistant-secretary and assistant-treasurer, Albert Norris.

Progress in Rail Sizes.

An old friend writing to one of our editors concerning the development of railroad permanent way says that on the Camden & Amboy division of the Pennsylvania Railroad there have been experiments made with different styles and shapes of that representing the whole progress of permanent way for all the railroads on this continent.

There are now on record nearly seventy different shapes and dimensions of rails that have been put upon the track since the line was opened in 1831. This ranges from the strap rail weighing 9 pounds to the yard to the modern 100-pound rail. The strap was the first rail used and measured 2 inches wide and ⅝ inch thick. The first "T" rail succeeded the strap rail within a year, and was 36 pounds to the yard, and was soon followed by one weighing 40 pounds to the yard. In 1835 the weight had increased to 42 pounds to the yard, in 1846 [illegible] pounds to the yard, in 1848 [illegible] pounds to the yard, which held its own for several years. The rail was 7 inches high with 4½-inch base. In 1892 rails weighing 100 pounds to the yard were applied to the Camden & Amboy division. This rail is 5½ inches high by 5½ inches base.

It is reported that the Westinghouse Electric & Manufacturing Co. and the American Rolling Mill Co., Middletown, Ohio, are also said to be working on orders for shrapnel. The Westinghouse Air Brake Co. is reported to have received an order for 1,000,000 shrapnel, valued at $20,000,000, from France.

"Some folks," remarked Old Jerry, as he waved aside the salesman's proffered cigar, "just take naturally to usin' any kind of tobacco.

"Like one of the boys I once knew who tried to get along without the little red tin of Dixon's Flake Graphite. He didn't seem to think that 'flake' meant any particular kind of graphite and 'Dixon's' any particular kind of flake.

"I never saw such a disgusted one as Pete was," chuckled Old Jerry, "after his graphite had balled up once or twice in his cylinders, and if it wasn't because the rest of us was usin' flake graphite he would have sworn up and down right there that graphite was the most durned fool stuff to us as a lubricant.

"'Pete,' I says, pullin' out my old Dixon Ad and grinnin' at the boys, 'it says here: "Write for 'Graphite Products for the Railroad and Sample No. 69.'"'

"'You're right, Jerry,' he says."

Joseph Dixon Crucible Company
Established 1827
39-C **JERSEY CITY, N. J.**

RAILROAD NOTES.

The Virginian is in the market for 500 underframes.

The Western Maryland is in the market for a number of passenger cars.

The Wilkesbarre & Hazleton is reported in the market for ten coaches.

The Norfolk Southern is said to be in the market for 1,500 tons of rails.

The Lehigh Valley will reinforce 2,000 freight cars with steel underframes.

The New York Municipal Railways are asking for bids on 100 steel subway cars.

The Pennsylvania Lines West are reported in the market for fifty locomotives.

The Kansas City Southern is said to be in the market for six switching locomotives.

The Delaware & Hudson has ordered two postal cars from the Barney & Smith Car Co.

The Wilkesbarre & Hazleton has ordered 10 interurban cars from the J. G. Brill Co.

The Southern has ordered 3,700 tons of steel rails from the Tennessee Coal, Iron & Railroad Co.

The Chicago Railways Co. have ordered 20,000 tons of girder rails from the Lorain Steel Co.

The Buffalo, Rochester & Pittsburgh has ordered 1,300 tons of rails from the Carnegie Steel Co.

The Sumpter Valley has ordered two Mikado locomotives from the Baldwin Locomotive Works.

The Champion Lumber Co. has ordered two Shay locomotives from the Lima Locomotive Corporation.

The Chicago, Indianapolis & Louisville is having 300 box cars rebuilt by the Haskell & Barker Car Co.

The St. Louis, Troy & Eastern has ordered 300 gondola cars from the American Car & Foundry Co.

The Atlantic Coast Line has ordered 6,000 tons of rails from the Tennessee Coal, Iron & Railroad Co.

The Chicago & North Western is said to be in the market for fifty passenger cars and 2,000 freight cars.

The Kansas City Southern is said to have ordered 6,000 tons of rails from the Algona Steel Corporation.

The Ponca Refining Co. has placed an order for 100 tank cars with the American Car & Foundry Co., it is said.

The New York, Westchester & Boston has ordered fifteen passenger coaches from the Pressed Steel Car Co.

The Lehigh & New England has ordered two switching locomotives from the Baldwin Locomotive Works.

The Missouri, Kansas & Texas has placed an order for 35 Mikado locomotives with the American Locomotive Co.

The Cincinnati, Hamilton & Dayton has started work on its new repair shop at Hamilton, Ohio, which will cost about $30,000.

The Grand Rapids & Indiana recently reported in the market for 3 consolidation locomotives, has decided not to buy at this time.

The Chicago & North Western has asked for bids on 2,000 box cars, 50 steel passenger cars and 50 steel underframe caboose cars.

The Western Maryland is said to be in the market for passenger cars and is preparing specifications for 1,000 55-ton steel hopper cars.

The Government Railways of the Union of South Africa are said to have ordered 30,000 tons of steel rails from the Dominion Iron & Steel Co.

The Pennsylvania Lines West have distributed an order for 150 steel underframes between the Ralston Steel Car Co. and the Greenville Steel Car Co.

The Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Co. is said to have ordered three gas-electric locomotives from the General Electric Co.

The receivers of the Chicago, Rock Island & Pacific asked permission of the court at an early date to purchase a large number of box cars, it is said.

The Minneapolis, St. Paul, Rochester & Dubuque Electric Traction has placed an order for three gas-electric locomotives with the General Electric Company.

The Pennsylvania will build 76 freight locomotives and 68 switching locomotives in its Juniata shops and work will commence at once on 50 freight engines.

The Illinois Central has ordered 4 Mikado locomotives from the Lima Locomotive Corporation, in addition to the 50 Mikados recently ordered from the same company.

The Pittsburgh, Cincinnati, Chicago & St. Louis has ordered 767 tons of steel from the Chicago Bridge & Iron Co. for a bridge over its tracks at West Lake street, Chicago.

The Chicago, Burlington & Quincy has placed an order for five Mikado locomotives with the Baldwin Locomotive Works, which are in addition to 50 locomotives ordered about a month ago.

Massacre of Trespassers.

The good old summer time has come and a great many American citizens have resumed the practice of rambling the wide world over, using the tracks of the railways as the favorite route of their rambles. We sometimes wonder if the danger of using railroad right of way with its numerous trains to be constantly eluded, does not form an attraction for Americans, as the people of no other country habitually use railroad tracks as if they were legal public highways. The habit, however, is extremely dangerous and an appalling number of people lose their lives every year because they will persist in trespassing on ground which the law prohibits them from using. Last [illegible] persons were killed and a like number injured while traveling on railroad tracks, and the year before the fatalities from the same cause were 5,558 more than the lives lost in the [illegible]. The New York *Globe*, commenting on this subject, says:

The case of the New Haven Railroad [illegible] 442 trespassers have been killed and 394 injured on its property. Comparatively few [illegible] them were factory operatives and farm hands who used the railroad right of way as a convenient highway, generally to make a [illegible] and the crippling permanently of so many [illegible] loss to the community and shows the need not only of a law in every state against trespassing but a rigid enforcement of it as well.

Railroads are the [illegible] ing [illegible]. The New Haven's efforts to prevent people from needlessly jeopardizing their lives, we are told, instead of being forwarded by those affected, more often than not are actually circumvented. Fences are torn down and warning signals defaced and destroyed. In Europe and Canada the deaths and injury from trespassing are comparatively few because the laws against trespassing are strictly enforced.

In thirteen states in this country such laws are on the statute books, but lax enforcement of them largely nullifies their efficacy. Not only should every state have a law forbidding trespassing on railroad property but offenders against it should be punished to the limit. Some day it will be realized that it will cost the states and towns less to enforce such a law than it now does to pick up and bury the dead and to care for the cripples.

A Curious Engine Failure.

Ordinary reporters who undertake to describe break-downs of machinery frequently produce racy reading, but we never remember anything better than the following paragraph copied from a Welsh paper.

A serious break-down occurred to the new engine operating the tramway system which has prostrated the running of trains up to date. The vigilant engineer in charge of the power house was listening to the action of the first class engine recently supplied from the works of Messrs. Williams and Thomas, when a sound reached his keen ears that was turbulent and alarming. He hurried at once to the sluice valve to shut off steam, and to his horror found that the vacuum had dropped into the [illegible] it upon its center. On examination of the engine it was found that the piston rod had dislocated the feed pump which runs the ball thrust bearings, throwing the links that operate the water pumps into confusion. The cause of the frightful accident was the breakage of a bolt that had been eaten away by vegetable matter that had accumulated in the incidental cylinder.

Heavy Orders for War Munitions in America.

The Canadian Car & Foundry Co. is said to be working on an order for shrapnel and other ammunition for Russia, said to amount to $80,000,000, of which $20,000,000 has already been advanced. A part of this business has been let to American companies.

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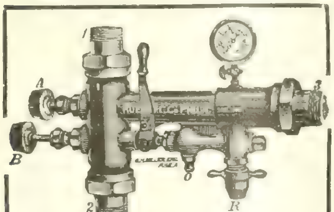

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Books, Bulletins, Catalogues, Etc.

Accident Bulletin.

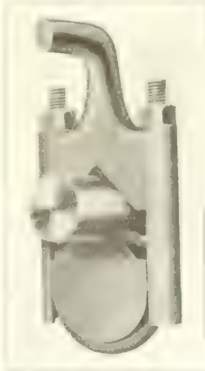
The Interstate Comm[illegible] has just issued Accident Bulletin No. 53, embracing a detailed list of collisions, derailments, and other accidents resulting in injury to persons, equipment, or roadbed, arising from the operation of railroads used in interstate commerce, and includes the period from July to September, 1914, inclusive. From the data supplied it appears that the total number of persons reported killed in all classes of accidents were 2,748, and the number of persons injured, 47,215. This statement includes 2,468 persons killed and 16,056 persons injured as the result of accidents sustained by employees while at [illegible] passengers getting off or on cars, by persons at highway crossings, by persons doing business at stations, as well as by trespassers and others. The remainder are classified under the heading of industrial accidents, and are not involved in train operation, but occurring to railway employees, other than trainmen, on railway premises. It would be idle to conjecture as to the result of the Safety-First movement in its effect on these appalling figures. Doubtless, but for its beneficient effect the list would have been larger. As it is the average of 10,000 persons killed every year by railroad operations seems to be maintained in spite of all remedial devices yet in operation.

Staybolts.

The Flannery Bolt Company, Vanadium Building, Pittsburgh, Pa., presents in the April issue of their monthly publication a highly interesting article on Boiler Shop Practice, embracing a number of interesting experiments in regard to the security and solidity of the connection of a Tate sleeve at various angles and other difficult situations in boiler practice, clearly proving that in many instances metals are ofttimes unjustly condemned by reason of fractures and breakages occurring from no other cause than that due to faulty manipulation of the operations necessary to the construction and assemblage of same, which in many cases are responsible for injury to the metal by the apparent evidence of grooves, nicks, distortion, etc., resulting from the methods and tools used in shop practice, a condition most keenly observed in late years, and very largely modified by establishing methods, tools, and practices, that has not only produced better work, but has most naturally raised the caliber of workmanship to a higher plane, where intelligent thought is directed in improving the art of construction, by the use of more suitable tools, and a better mode of operation, to more consistently safeguard the general quality of all metals in the manipulation of such, from the [illegible]

Armstrong Bros. Tools.

Catalogue A-12 issued by the Armstrong Bros. Tool Company, 339 N. Francisco avenue, Chicago, Ill., furnishes complete details regarding the company's products, including tool holders that have come into great popular use by meeting every objection to the use of high speed steel. There are over one hundred modifications of shape and size, adopted to all classes of work. The same may be said of the ratchet drills of the universal, short, packer, Nestor and standard reversible types. Of the drop forged wrenches it may be briefly stated that the designs and proportions are based upon practical knowledge of wrench requirements, while the most advanced modern equipment and manufacturing methods insure accuracy



and uniformity, both in machining and finish. There are also described and illustrated drill drifts, clamps, drill vises, planer jacks, lathe dogs, and an extensive variety of machine shop specialties, all the best in their kind. Among the more recent devices introduced by the enterprising company the Armstrong "U" clamp lathe dog has been found to be of much service in variable work especially in holding finished work which is liable to be damaged by the use of the common set screw in the ordinary lathe [illegible]

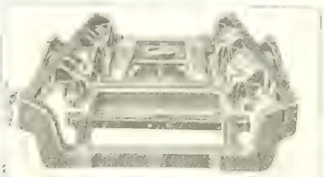
[illegible] close-fitting U bolt, and can be adjusted to size very quickly, and can be applied without removing work from centers and possesses a wide range of adjustment. Other important improvements, particularly in the smaller kinds of tools, are worthy of particular notice, and those interested should secure copies of the company's interesting publication. Copies of [illegible]

Forcing Presses.

[illegible] not now be described and illustrated in one catalogue, although No. 92, just is- [illegible] 128 pages and present in a general way some of the leading products in hydraulic appliances, and also furnishes reference keys to the many separate catalogues issued by the company. It has been found from experience that it is advisable to divide the tools into classes, making each [illegible] Any one of these catalogues will be mailed on application to the company's office. Catalogue No. 92 is itself an admirable example of the manner in which a publication of this kind should be arranged. The tools illustrated are evolved from designs made many years ago, and in their present form embody all of the improvements that time and experience has proved advisable. Strength and simplicity are their outstanding features. Their growing popularity is the best proof of their superiority.

Commonwealth Steel.

The Commonwealth Steel Company, Pierce Building, St. Louis, Mo., have issued a finely illustrated catalogue of 74 pages, descriptive of their open hearth cast steel devices for railroads. These embrace underframes, platforms, endframes, double body bolsters, needle beams, end sills, trucks, truck bolsters, pilot beams, tender bumpers, engine and [illegible]



wheels, and a variety of freight car de- [illegible] complished skill and experience in [illegible] made by the Commonwealth company is universally acknowledged to be admirably [illegible] ber of the leading railroads. This is [illegible] truck which is growing more and more in favor and has been selected from among many competitors for service under the first class trains all over America, itself to be an important improvement in tender construction, combining as it does end sills, body bolsters, needle beams and other parts into one strong, durable, simple casting that has stood the test of the hardest kind of service. For fuller details, all interested should secure a copy of the company's latest [illegible]

The Safety Heating & Lighting News.

Twenty-eight years of a vast and varied experience in car lighting has brought a degree of perfection to the products of the Safety Car Heating and Lighting Company that is not surpassed, if indeed it is equalled, in any part of the world. The company's monthly publication is luminous with information in regard to their multiplex devices. New problems are being constantly solved by the company's experts and the grace and elegance of their equipments commands universal admiration. Then much of the best work is not seen. Among the more recent in this department of endeavor is the suspension of the generator from the underframe of the car instead of from the truck as formerly. A number of these equipments are now in actual service and are giving much satisfaction. The result is a large reduction in weight with increased clearances between the end sill or brake rigging and belt, and also increased clearance between the generator and the track, affording greater accessibility for inspection and repairs besides a marked increase in ease of in- [illegible] get the complete details of the improved equipment.

Reactions.

The quarterly publication devoted to the science of aluminothermics, published by the Goldschmidt Thermit Company, 90 West street, New York, furnishes an ever-growing view of the expansion of the use of thermit in welding operations in every conceivable kind of metal work. The rapidity with which crossheads, [illegible] tons, driving wheels, frames, rocker arms and other intricate parts of locomotives and machinery generally that may be broken in the course of their strenuous [illegible] publication surpasses its predecesser in interest because of the added variety of illustrations and descriptions of work never done before. It seems to us that the marvellous expansion of the application of thermit is greater in railroad shops than in any other kind of repair [illegible] *actions* for the first quarter of 1915 and see [illegible]

[illegible] Management of Railway and Locomotive Engineering, published monthly at New York, N. Y., required by [illegible]

[illegible] St., New York, N. Y.

Managing Editor, James Kennedy, 114 Liberty [illegible] Business Manager, Harry A. Kenney, 114 Liberty St., New York, N. Y.; Publisher, Angus Sinclair Co. (Inc.), 114 Liberty St., New York, N. Y.; Owners, Angus Sinclair, 114 Liberty St., New York; James Kennedy, 114 Liberty St., New York; Harry A. Kenney, 114 Liberty St., New York; Mrs. Otto J. Schlanbacher, 114 Liberty St., New York.

[illegible] ndholders, mortgagees and other se- [illegible] more of [illegible] other [illegible] urities: None.

[illegible]

Gen'l Mgr.

Sworn to and subscribed before me this first day of April, 1915.

[illegible]

[illegible] 30, 1917

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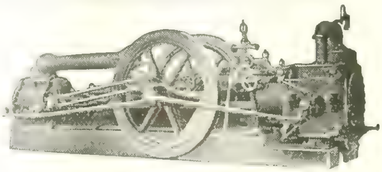

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Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVIII. 114 Liberty Street, New York, June, 1915. No. 6

Electrification of the Elkhorn Grade, Bluefield, Norfolk & Western Railway

Another important addition to the electrification of American railroads in congested traffic districts has just been completed and is now in active operation. That portion of the Norfolk & Western railway known as the Elkhorn Grade, is located on the main line in the southern part of West Virginia, about 105 miles west of Roanoke, and extends from Bluefield to Vivian, a distance of about 30 miles. This section is double track throughout, except in the Elkhorn tunnel, which is single track. There is also a large amount of third track, or passing sidings and branches into the coal workings, and yard trackings.

The grades vary from 1.0 per cent. at the west end to 1.5 per cent up the grade, to and through the summit tunnel, a distance of about 10 miles, then descends on a 2.5 per cent grade for about a mile and rises again about 0.25 per cent. for 10.5 miles, and finally up a 1.22 per cent. grade for three miles into Bluefield, the easterly end of the division. Fully 60 per cent. of the line is on curves, the maximum being about 12 degrees.

The electrification of this section is for the purpose of more readily collecting from the mine sidings and yards in the coal fields the entire eastbound coal tonnage and transporting it over the summit to Bluefield. From thence it is shipped east to various points, chiefly to the company's marine shipping pier at Lamberts Point, near Norfolk, Va. The heavy freight trains are moved by electric locomotives at a speed up the grades of 14 miles per hour, as compared with about 7½ miles per hour under steam operation. The effect of increased speed is especially marked at Elkhorn tunnel, 3,000 feet long on 1.5 per cent. grade, where under steam the speed up grade is about 6 miles per hour, taking about 7 minutes, while the electric locomotives pass through the tunnel in 3 minutes.

The heavy trains of 3,250 tons required three steam locomotives over the entire section. These locomotives are of the heavy Mallet type, equipped with superheaters and mechanical stokers. Under electric operation a single road engine is used over the division, and a pusher, also electric, is added up the 1.5 and 2 per cent. grades. In some parts of the section the electric locomotives make a speed of 28 miles per hour.

TYPE OF ELECTRIC LOCOMOTIVE ON THE NORFOLK & WESTERN RAILWAY

The equipment provides for handling 20 tonnage trains per day, and this can be enlarged when required. The single phase system is used, power being generated, transmitted and distributed single phase at 25 cycles and collected from the overhead catenary trolley contact system at 11,000 volts. The locomotives, how-

[illegible] equipped with phase converters, which, in connection with the main step-down transformers in the locomotive, transforms the [illegible] to three

[illegible]

phase power for use in the three-phase induction type traction motors. Another feature is that without the use of complicated apparatus it is possible to utilize the locomotive for electrically holding or braking trains at constant speed while descending grades. This utilizes the energy in the moving train descending the grade to drive the motors as generators and thus return energy to the line. [illegible] for heavy freight service, and it is eminently successful.

The line supports are light bridges made of tubular poles and Bethlehem "H" section crossbeams, and the structures are guyed on the outside of curves to resist the curve pull by means of heavy guy rods secured to concrete anchorage. [illegible] and telephonic connection is maintained with all points. Fans are also used for ventilating the Elkhorn tunnel and are driven by electric motors. The main turbo-generator units, exciters and signal generators are located on the main floor of the turbine room of the power house. [illegible] cooling the generators being in the basement. [illegible] a 30-ton traveling crane. The basement floors are at the ground level, while the turbine room floor is 18 feet and the [illegible]

An idea of the dimensions of the building may be gathered from the illustra-

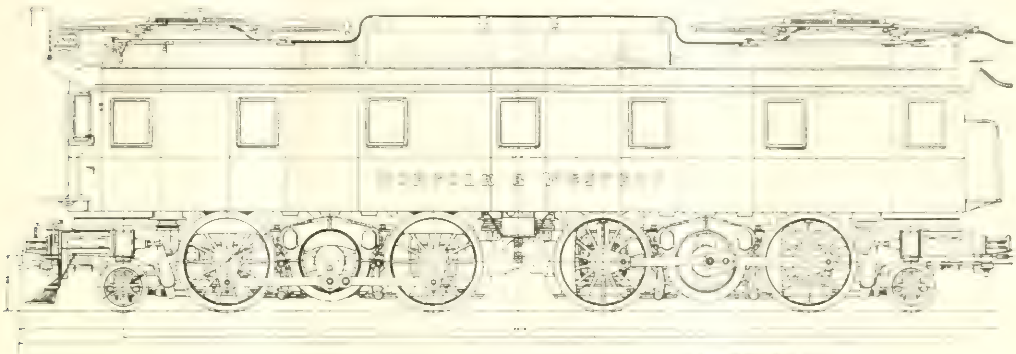
[illegible] 268 feet [illegible] 20 feet. The initial equipment consists of three main generating units, with space provided for a fourth. These units are [illegible] Westinghouse Parsons impulse reaction double floor type, rated at 10,000 kw., with steam at 190 pounds, superheated 150 deg. F. and 28½ [illegible] gallons per minute. [illegible] circulating pumps of all condensers is discharged into a cooling pond which [illegible] station. It is 90 feet wide, 286 feet long and 5 feet deep. At the west end of the pond is a sluice gate which discharges into the river. At the southeast corner of the basin a 36-inch pipe fitted with a gate valve leads to the intake canal. The pond is capable of cooling 16,800 gallons per minute.

The main turbo-generators are of the Westinghouse type, having a rating of 10,000 kw. at 80 per cent. power factor, 11,000 volts, 25 cycles, single phase. They are capable of delivering a single phase output of 12,500 kw. at 80 per cent. power factor without injurious heating. The armatures are wound for 3-phase power, and are insulated for a one minute voltage test of 22,000 volts. Thermo couples imbedded in the armatures furnish a continuous temperature record. A Tirrill regulator is used to vary the exciter voltage and current over sufficient range to insure practically constant voltage on all three main generators under all operating conditions. Two turbine-driven generators are also used for signal service in the electrified zone. One advantage of using a very high voltage on the contact system is that no supplementary feeders are required, the distribution of power from substations being effected by means of the trolley lines [illegible]

There are now in service twelve 270-ton Baldwin-Westinghouse locomotives, each consisting of two 135-ton units or halves. Each unit has two main trucks connected by a Mallet type hinge, and each main truck has two driving axles included in a rigid wheel base with a radial two-wheeled leading truck. The bumping and pulling stresses are transmitted through the main truck frames and through twin draft rigging mounted on the main trucks at each end of the unit.

[illegible]

The cab is of the box type, and is supported on the main truck entirely by spring cushioned friction plates, there being no weight on the center pins, which serve only to maintain the cab in its proper position on the trucks. Each locomotive is provided with eight traction motors of the three-phase induction type,

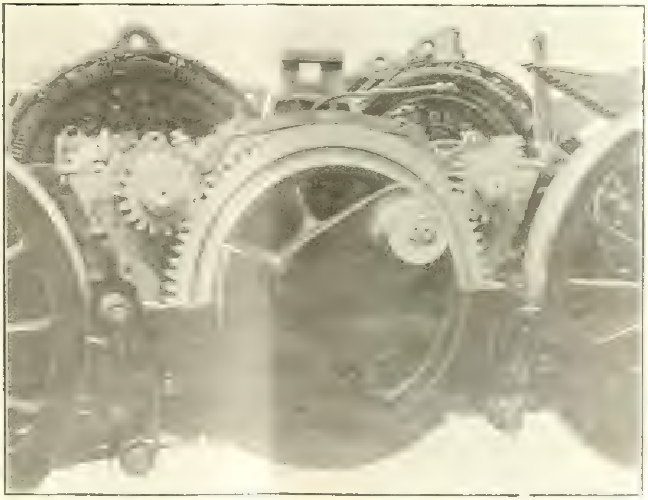


ELEVATION VIEW OF ELECTRIC LOCOMOTIVE, NORFOLK & WESTERN RAILWAY.

with wound secondaries for four-pole and eight-pole operation. The motors are force cooled by air from the main ventilating duct, which also delivers air to the phase converter and to cooling towers for the liquid rheostat

It will be observed that the power from the motors is transmitted to the drivers through a jack shaft and side rods. The illustration shows two motors on one truck with the pinions on the end of the armature shafts engaging with the large gear, which is pressed on to the jack shaft carried in heavy bearings on the locomotive frames. This is a novel feature on heavy locomotives, and is shown very clearly on the elevation view. It will be noted that the gear is encased to prevent the grease from becoming mixed with grit or other substances.

There are two running speeds, 14 and 28 miles per hour. Two trolleys are mounted on the roof of each unit. They are of the well-known pantagraph type. For the purpose of cooling the various pieces of apparatus there is a 36-inch Sirocco fan mounted on the shaft of the phase converter, and arranged to deliver the air to a duct built into the [illegible] under the deck. The duct runs lengthwise through the cab, and is arranged with openings at various points where connections are made to the traction motors, phase converters and cooling towers.



[illegible] PINIONS [illegible]

The following are the principal dimensions and weight of these locomotives:

Length over-all—105 ft. 8 ins.
Driving wheel base—83 ft. 10 ins.
Rigid wheel base—11 ft.
Truck wheel base—16 ft. 6 ins.
Height, rail to pantagraph locked—16 ft.
Height, rail to top of cab—14 ft. 9 ins.
Width over-all—11 ft. 6¼ ins.
Width over car body—10 ft. 3 ins.
Diameter of driving wheels—62 ins.
Diameter of truck wheels—30 ins.
Weight on drivers—220 tons.
Tractive effort—133,000 pounds.
Horsepower developed—6,700.

It may be added that the entire electrification work of installation, details of design of electrical apparatus, including power house, locomotives, line construction and signalling, has been carried on under the supervision of Gibbs & Hill, consulting engineers, New York City.

New Equipment for the Intercolonial Railway.

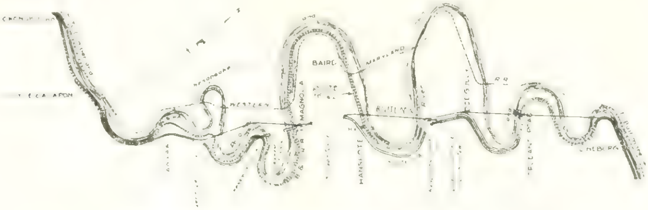
The Intercolonial is spending nearly $3,000,000 this year on equipment. This includes 12 super-heating locomotives, 10 Pacific type locomotives, 6 consolidated locomotives, 4 switching locomotives, ballasting equipment and rail loaders, 200 steel flat cars, 250 steel gondola cars, 4 light wrecking cranes, 8 sleeping cars, 4 steel sleeping cars, 4 baggage cars, 2 postal cars, etc. Some of this equipment has been delivered and placed in service. Double-tracking was part of an ambitious programme, which called for the outlay of several million dollars, but this is postponed for the time being. As regards the condition of the roadbed, the new and strengthened bridges, the new and enlarged stations along the line, and the new modern equipment, gradually being placed in service—the system shows marked and gratifying improvement. An outlay of $24,000 has just been made for the most recent safety appliances for

Extensive Improvements on the B. & O. R.R.

Details of the Magnolia Cut-off

[illegible] improvements in American railroads, and known as the Magnolia Cut-off, occuring on the Baltimore and Ohio railroad, and calling for engineering skill of the very highest order, has been described and illustrated by Mr. A. W. Thompson, vice-president of the company, and published by the Engineers' Society of Western Pennsylvania. The improvements provide for the additional tracks and facilities which were absolutely necessary in order to handle the present heavy business, and provide for a reasonable increase.

This section is known as the first portion of a four-track system which will be gradually extended from Patterson Creek to Brunswick, a distance of 95 miles. It [illegible] scheme which is in line with a general grade revision of the Baltimore and Ohio railroad [illegible] and



[illegible] BALTIMORE & OHIO RAILROAD

[illegible], Looking East.

[illegible]

This grade scheme is [illegible] grade that can be secured. When in full operation it will provi[illegible] least $500,000 a year. It will dispense with [illegible]

The cut-off improvement begins at Orleans road, rising on a 0.4 per cent com[illegible] it begins to descend on a 0.1 per cent compensated grade to Little Cacapon, a distance of twelve miles. A saving of 5.78 miles in distance and 877 degrees in curvature is effected.

It will be noted on the accompanying chart, beginning at Orleans road, that the windings of the Potomac river are somewhat tortuous and the hills, although not over 300 feet in altitude, are clustered thicker than the stars in the milky way of heaven. At Doe Gully the original Doe Gully tunnel is removed and excavations made for four tracks, and instead of following the river it passes through Randolph tunnel, which is 1,014 feet in length. Partially following the old tracks, the new road diverges to the south and passes through Stuart tunnel, 3,318 feet in length. Emerging at Magnolia at right angles to the old line, it crosses it at an elevation of 50 feet on an extension of [illegible] Potomac river bridge [illegible] 1,[illegible] feet in length, and another loop of over two miles of the winding river is saved. The river is again crossed at Kessler's curve. There the old and new tracks run parallel, the new tracks being 40 feet above the old tracks, with a massive retaining wall 1,800 feet in length provided between them. West of this the new line again diverges from the old for a short distance, and passes through Carothers tunnel, 1,000 feet in length. At a short distance west of Paw Paw, where the river is very narrow, it was found necessary to construct a retaining wall 3,100 feet in length along the riverside to avoid further hillside work.

The construction of the Magnolia Cut-off completes a budget of improvements on the Baltimore and Ohio which was authorized and started by President Willard in the early part of 1911. All of the improvements presented problems difficult of solution. The cost of the work is below the estimate, the total approaching $6,000,000. The entire work has been carried out to the complete satisfaction of the management.

Proposed Railway Extension in Bolivia.

The government of Bolivia has announced its intention of beginning at once the construction of a railway line from Tupiza in the southern part of Bolivia to La Quiaca in the northern part of Argentina. La Quiaca lies practically on the boundary line between Bolivia and Argentina and is the northern terminus of one of the great Argentina lines. Tupiza lies on the Bolivian railway system and is connected with the Pacific coast by three lines touching the coast in southern Peru and northern Chile, and the connection of these two lines, now proposed by the Bolivian government, will give another transcontinental railway line for South America. The Bolivian railway system consists chiefly of a north and south trunk line through the great elevated region in the vicinity of Lake Titicaca, which line is connected with the Pacific coast by three distinct lines running respectively to Antofogasta and Arica, Chile, and Mollendo, Peru.

General Foremen's Convention.

The tenth annual convention of the International Railway General Foremen's Association will be held at the Hotel Sherman, Chicago, Ill., beginning July 13, 1915, and continuing during the succeeding three days. The subjects of the various papers embrace "Valves and Valve Gearing"; "Rods, Tires, Wheels, Axles and Crankpins"; "Shop Efficiency"; "Roundhouse Efficiency"; "Oxy-Acetylene Welding." Every effort is being made to make the attendance the largest in the history of the association, and the Executive Committee of the Association of Railway Supply Men are arranging to make the exhibit of railway appliances the best ever shown at any convention. Exhibit spaces are being assigned by the committee in the order in which applications are received. Particulars in regard to exhibit spaces will be furnished by Mr. J. J. Dale, secretary and treasurer, 545 Washington Boulevard, Chicago, Ill.

The Proper Lubrication of Triple Valves

Oil Lubrication More Than Useless

Graphite the Proper Lubricant for Slide Valve and Seat

By WALTER V. TURNER

Assistant Manager, Westinghouse Air Brake Company

In order that my position with regard to the subject of lubricant for triple valves, especially for the triple valve slide valve, may be entirely clear to the readers of this paper regardless as to how any recommendations may be construed, I am constrained to state first that I do not favor any liquid lubricant for use in a triple valve for the reasons which follow, as well as because oil does much harm and little, if any, good, as it is merely a dust collector and makes what we know as a "dirty, gummy, sticky valve." Also, oil, like "charity, covers a multitude of sins"—sins of improper and slighted work, such as loose rings, leaky parts, etc., and there is much harm and trouble concealed in the temporary "doctoring" of the triple valve. A very slight quantity of the very best grade of graphite should be used on the slide valve and seat. These are the only parts of the triple valve that should be lubricated. If such a graphite is not on hand, no lubricant at all should be employed. That is, a triple valve, without lubricant may be brought up to the present standard of efficiency required and in all probability will remain in such a state for a longer period of time than if liquid lubricant is used on the slide valve. The reason for stating this in the above manner is that it will be remembered that the troubles from undesired quick action which very actively engaged the attention of practically every air brake man in the country for several years, was finally run down to a point where it was readily recognized that every contributing cause tended to one effect, in fact, it was summed up to a point where there is but one cause of undesired quick action, namely, an excessive differential of pressure on the sides of the triple valve piston during the application.

Further investigations and elaborate experiments then proved that the triple slide valve under compressed air offered considerable more resistance to movement when lubricated with oils or grease than when perfectly dry which at first glance may indicate a variation in the generally accepted laws of frictional effect, however, those laws are not applicable, as the resistance of the triple slide valve to movement is controlled by the pressure per square inch, effective upon the area exposed to the auxiliary reservoir and by the per cent. of the wearing area that can be reached by leakage from the auxiliary reservoir to the atmosphere which tends to balance the pressure on the slide valve.

Thus with a film of oil about the edges of the slide valve which, if the valve and seat are practically true, packs it to the exclusion of leakage, and the full weight of the auxiliary reservoir pressure is effective, whereas, if this pressure through a dry valve and seat is permitted to percolate through the wearing surfaces, the tendency is to produce a balance and reduce frictional effect, this being exemplified or rather illustrated in air compressor operation where a reversing slide valve, free from leakage, sets up a resistance to movement that results in excessive wear on reversing plates and valve rods, but when the slide valve is leaking the pressure is frequently balanced to such an extent that the valve and rod will move by virtue of their own weight and result in an erratic compressor action.

When this effect was found inherent in the triple slide valve operation, the reason for epidemics of undesired quick action following in the wake of an unusual activity in cleaning and lubricating triple valves became obvious.

This in itself should make clear my attitude, any lubricant that will seal the edges of a triple slide valve against leakage is undesirable and almost positive to produce some undesired results, however, a heavy bodied valve or cylinder oil has been used and in some cases is still being used in such minute quantities that no particularly bad results are experienced, but it is the exclusion of leakage, or the packing, that is to be avoided, whether it be from water or from brake cylinder grease deposited on the valve seat during a release, hence it is evident that an exceptional amount of care should be exercised in lubricating brake cylinders, a thin film on the wall of cylinder being sufficient.

Through an extensive investigation of conditions of triple valves in service it has been found that at the end of 3 months service a paper impression of the slide valve and seat scrutinized with a microscope reveals no indication of the presence of any lubricant, hence the assumption that in freight service the valve and seat is dry for a period of 9 months out of the 12, giving satisfactory service, obviously there will be no undue wear and a greater degree of freedom from undesired quick action if the valve and seat are permitted to run dry for the entire 12 months between cleaning periods.

By leakage between the slide valve and seat, I do not mean that which can be detected with the hearing or a torch or even with a particularly noticeable rise of a soap bubble placed over the exhaust port, but that infinite and inevitable quantity that may enter between a dry slide valve and its seat and tend to establish a balance in pressure and reduce the total resistance to movement thereby reducing instead of increasing the actual amount of wear of the slide valve on its seat.

The practice of lubricating the wearing surfaces of brake operating devices is universally accepted as necessary and to thus desist would in itself be an innovation, hence the compromise on fine dry graphite which if correctly applied adheres to the valve and seat in a manner that still permits of the amount of leakage necessary to destroy the major portion of the full frictional resistance that is obtained from an oil or water packed slide valve. However, the selection of a suitable grade of graphite and its proper application is in itself a difficult proposition to say nothing of the difficulties encountered in the effort to keep the graphite dry after its application.

I would invite your careful consideration of this subject of lubrication in connection with triple valve operation as we can no longer consider the cutting out of brakes and estimate a certain per cent. operative as there is no such thing as per cent. operative to be considered, the whole train must be assumed as one brake from the air compressor to the rear angle cock and the rail and any portion of it cut out or inoperative produces a defective brake and in the last analysis must be considered as such.

Also, the differences between a rate of brake pipe reduction that must produce service action and one that must develop quick action leaves a comparatively small margin in which to compensate for the introduction of outside elements or variable influences even under favorable conditions because there is a point at which an excessive rate of service reduction through leakage or other causes may encounter a slide valve resistance that tends to bottle up the auxiliary reservoir volume and create the undesired result, therefore a close study of the various factors involved will lead to an appreciation of how nearly this dividing line is frequently approached without producing quick action and on the other hand how extremely difficult it sometimes is to obtain quick action when it is

In a future issue I hope to again touch upon this very important phase of triple valve operation.

Construction and Use of the Dynamometer Car

Its Advantages as An Economizer Pointed Out

By HUGH G. BOUTELL, Washington, D. C.

[illegible] is in-creasing so rapidly on our leading railways that every engineer should have at least an elementary knowledge of their [illegible] uses to which they may be put. During some recent tests on one of the leading eastern roads I was greatly surprised at the lack of information concerning the dynamometer car shown by the engineers and firemen. The main idea seemed to be that it was some sort of a device to "catch up" the men, like a surprise test, that it was a great nuisance and its arrival on their division was to be regarded as a calamity.

The dynamometer car is really very simple and its use is in the interests of both the enginemen and company alike. When used purely for engine testing it shows the advantage of one class of engines over another, and results in the use of power best suited to the special requirements of each division of the road. When the car is also used in connection with tonnage rating, the greatest objection is apt to come from the enginemen, but they should remember that the tonnage is never raised unless it is clearly demonstrated in a large number of test runs that the higher tonnage can be hauled in the regular course of business. [illegible] with [illegible] the use of a dynamometer car causes a lowering of the weight of trains and thus puts an end [illegible]

It would be a good thing if every engineer on the road could make at least [illegible] He would learn more about how his own engine behaves under different conditions than in a hundred rides in the cab. The pointer on the gauge which gives the draw-bar pull in pounds, shows every rise and fall in the road, just why it is difficult to pull out of a certain siding and why a short train pulls so much harder than a long one on that little hill beyond the water tank.

The elementary principle of the dynamometer car is illustrated in Fig. 1. A is the tender, B the first car of the train [illegible]

That is all there is to a dynamometer, in theory at least, but practically such a device would not be a success. A spring of sufficient size to measure the pull of a locomotive would not be sensitive [illegible] the pull, and secondly we would have no record of the amount of this pull run be of a permanent character, so that it can be referred to and worked up at any time, all dynamometer cars are equipped with some form of recording mechanism.

The simplest form of recording dynamometer mechanism is shown in Fig. 2. A is the underframe of the car, B one of the wheels, running on the rail C. D is the coupler, attached to the short end

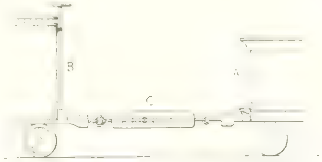
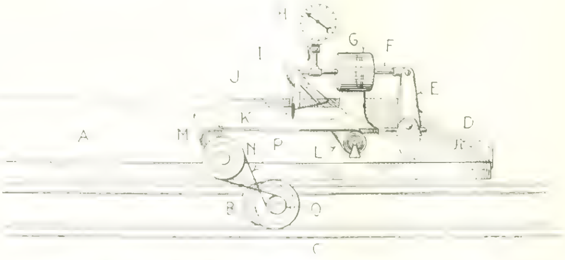


FIG. 1. PRINCIPLE OF THE DYNAMOMETER

of the vertical lever E, which is pivoted at the underframe and has its upper end connected to the piston rod F. This rod works a piston in the cylinder G. The cylinder contains a liquid, usually a mixture of glycerine and alcohol, and has a small pipe connecting it with the small cylinder I and the gauge H. The cylinder I is exactly like that of an ordinary steam engine indicator, and any motion of the piston in this small cylinder is transmitted to the pen or pencil J. This pen traces a line on the chart K, which is rolled from the spool L onto the spool M by means of motion transmitted from the wheel of the car through the pulleys N and O and the belt P.

[illegible] coupled to the car, as soon as it starts to pull on the coupler D, the lever E will transmit this force to the piston rod F and produce a pressure in the cylinder G. This pressure is very high at the coupler, but it is quite small in the cylinder, owing to the proportions of the lever, and the comparatively large diameter of the cylinder G. The liquid in this cylinder will be forced through the pipe and cause a motion of the indicator piston I and the pen J will start to trace a line on the chart K. This chart will travel from the spool L onto the spool M with a motion proportional to that of the car wheels. Now it will readily be seen that if our chart has a certain fixed line, called the base line, already ruled upon it, the distance of any point on this base line from the line drawn by the pen will be a measure of the draw-bar pull, and if we have the paper suitably graduated we can at once read off the pull in pounds. Such a chart is shown in Fig. 3, and is a fair example of all the charts made by dynamometer cars.

It will be obvious that the spool M could just as well be driven by some other source of power than the car wheels, and this is frequently the case. The usual arrangement then is to drive the paper mechanism by a constant speed electric motor. Where the paper is operated by the car wheels the machine is said to have a "distance base" and where it is driven by a motor it has a "time base." That is, in the first case the paper moves a distance proportional to the distance covered by the car, say one inch per 1,000 feet, while in the second case the paper moves equal distances in equal periods



[illegible]

of time. On some cars, notably two recently constructed by the Southern Railway, the paper may be driven either way by the manipulation of a lever.

This is all the mechanism there would have to be on a simple dynamometer car for measuring and recording the drawbar pull, but there is one other element of the greatest importance in all our calculations, and that is the time it takes the train to cover a given distance; in other words, its speed. Mounted in the car is a chronometer, electrically connected to a pen which traces a second line

on the chart. The mechanism is so designed that the pen makes a jog in the line for a certain number of seconds ticked off by the chronometer. Thus, if we have a pen that makes a record every twenty seconds and we find three such marks in a distance of 1,320 feet, we know that the train was making 1,320 feet per minute, or 1,320 × 60 ÷ 5,280 = 15 miles per hour. Now we know that force multiplied by distance equals work. Thus, in Fig. 3, taking the shaded area, abcd, we find that it has an average height rep-

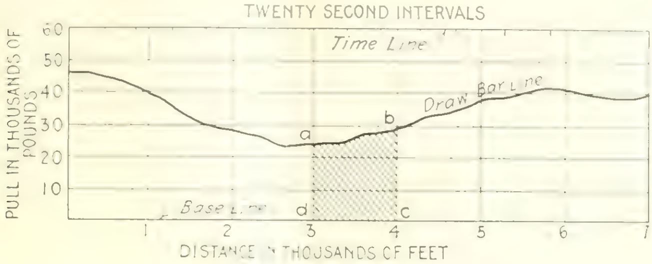


FIG. 3. TYPICAL DRAWBAR RECORD.

resenting 27,500 pounds, and a length representing 1,000 feet. The work done at that time was, therefore, 27,500,000 foot-pounds. Horse power is equal to doing 33,000 foot-pounds of works in one minute. We find that this 27,500,000 foot-pounds of work was done in 43 seconds. To find the horse power of the engine at that time we therefore divide 27,500,000 by 33,000 and multiply by 60 divided by 43.

Thus:

$$\frac{27,500,000}{33,000} \times \frac{60}{43} = \text{[illegible] power.}$$

At the same time that we record the draw-bar pull and speed it would probably be of value to have a record of the steam pressure, brake pressure, amount of coal burned, water evaporated, etc., and nearly all cars are provided with apparatus for recording this data. Some cars have a very wide chart and twenty or more pens, and at first sight the mechanism appears to be very complicated, but if separated into its component parts it is found to be quite simple, and the main features are like those first described; all the other devices being of an auxiliary nature.

The methods used in simple engine testing are probably well known to all up to date engineers, but one or two features of tonnage rating may be mentioned here.

There are two important points that must be considered in making a rating for any division. They are the weight of the train and the number of cars in the train. In general, if two trains are of equal weight the shortest one will be the easiest to pull. The reason for this is that the car friction is less in a short train than in a long one. Thus, while an engineer might make time with a loaded train weighing 2,000 tons, he might fail to make the required schedule with a train of empties weighing 2,000 tons. On the other hand, if there is a very short, steep hill on the division, less in length than the longest train, it will be found that the man with the long train will be able to get over the hill while the man with the short train may stall, since in his case *all* the weight is on the hill at once, while with the long train some of the cars are on the level all the time.

Curves, of course, increase the friction, and cut down the tonnage, also, and then, too, very often the ability to pull up a certain hill depends on whether it is necessary to stop at the bottom of the grade or not. No rating should be made that requires the dangerous practice of running at hills at excessive speed in order to get over them, but, on the other hand, trains should never be required to make a stop at the bottom of a stiff grade where it can possibly be avoided.

Often the dynamometer car has shown where a pusher at just one little hill, perhaps two miles long, can raise by several hundred tons, the rating on an entire division. It shows where unnecessary stops should be cut out and where too much doubling has occurred. On the whole the "test car" is a friend of the engine crews and should be so regarded by them.

As we stated at the outset it is surprising the amount of opposition that has been shown towards this useful device, but it seems that all improvements, especially on railroads, meet with a degree of opposition that seems extremely senseless when the final triumph comes.

Strength of Corrugated Plates in Fireboxes

Advantages of Their Use in Locomotive Construction

By WM. H. WOOD, M. E., Media, Del. Co., Pa.

I should like very much, through your valuable columns, to correct a misapprehension which seems to be in the minds of several chief mechanical engineers and superintendents of motive power whom I have consulted on our large Eastern railroads.

The misapprehension is that staybolt centres cannot be changed from 4 ins. x 4 ins. in locomotive fireboxes, no matter whether the inner firebox sheet be corrugated or not. Now, since it has been recognized by the United States marine regulations that a corrugated plate is equal to a straight plate, 50 per cent. thicker, it should be plain to these people that the centres can be changed. If this is made more familiar to them they may be more willing to avail themselves of a modern construction which offers the following advantages:

1. Increased heating surface.

2. [illegible]

3. Reduction in stays to the number of 750.

4. Staybolt centres 5¼ ins. x 5¼ ins., instead of 4 ins. x 4 ins.

5. Boxes, when corrugated, 8 times stronger than flat plate construction.

6. The permanent set-in flat plate construction overcome by the corrugated construction.

7. No weakening of outside firebox plate by increased area required for articulated or flexible stays.

8. No flexible stays.

9. No leaky mud rings, the tension of stresses coming from back of firebox to firebox tube plate, being neutralized by the corrugations.

10. Scale broken up, as fast as made, by the expansion and contraction.

11. No leaky tubes, owing to the front and firebox tube plate corrugations encircling the tubes and allowing them expansion and contraction at will.

12. Loco efficiency 7.77 per cent. greater.

A 3/8-in. plate, 9/16 in. corrugated, with shallow corrugations, is equal to a flat plate 9/16 in. thick, and for this the Massachusetts regulations would allow a staybolt spacing of 6¾ ins. x 6¾ ins., thus the 5¼-in. x 5¼-in. centres would be greatly in excess of the safety factor. And as regards the scale, the boilers in practice are washed out every 15 days and from three to five barrowsful of broken scale taken from the cleaning holes around the mud rings. In fact that corrugated fireboxes are to the locomotive boilers what the Fox & Morrison furnaces have been to the Scotch marine boilers; for, I have had a boiler of the Atlantic type, with superheater tubes for three years and giving satisfaction

Among the Old and New Wood Burners

By DAVID N. HARRIS
Newark, New Jersey

[illegible] on arriving at home, I was pleased to read the interesting article on the wood burning engines on a short road in North Carolina. These old timers are always interesting to us old boys who used to chuck the blocks when we were young, so I think that a few words in regard to another road in the Southland may be interesting.

The Tampa & Gulf Coast road, recently extended to St. Petersburg, Fla., a distance of 55 miles, have all of the engines of this road burn wood. Nearly all their engines have the balloon stack and short smoke head.

There are several Baldwin engines with extended smoke box and straight stacks, which were turned out June, 1914. I saw some of the older engines built by the Rhode Island Locomotive Works in 1883. The last engine of this kind which I had previously seen was running on the road from Salt Lake City to Great Salt Lake in 1912. Seeing the fireman standing in the tender and slinging the wood through the furnace door I remarked to the engineer that when I chucked the blocks we were always careful to land them crosswise so as to fill up all empty space. He remarked that the wood they used would burn regardless of how it landed and make steam so long as it was in the furnace.

The wood appeared to me to be all dead wood. The shop number of the first Baldwin engine that I remember was No. 146, a little 4-2-2 engine that was on the Morris and Essex division of the Lackawanna road; the shop number of the Baldwin engine on F. & G. C. road 41,479, engine No. 19.

I have often observed the distance from home we see cars from another road. I observed at St. Petersburg freight cars from the New Haven and the Central of New Jersey, also baggage and combination cars from the Pennsylvania.

Selection of Locomotive Fuels

By ROBERT W. ROGERS, A. M. E.
Port Jervis, New York

[illegible] been discussed from many sides. It is proposed to give an outline of the latest practice in Europe, and some conclusions can be drawn by the reader which may be of interest.

The first question that enters into the subject is that the fuel should be practically as smokeless as possible. The unlimited amount of smoke and unhealthy gases which are emitted daily from factories and locomotives and spread over the local neighborhood can be mitigated. These gases not only are unhealthy, but also indicate an uneconomical use of fuel.

In the stationary boiler plant where it is possible to build a chimney of such a height that the smoke and soot are not so heavy it is not hard to provide for the health of surrounding neighborhoods. It is quite different with the locomotive which carries its smoke and exhaust gases through crowded districts, especially when it is called upon to work under a heavy load or at railroad stations or terminals. The railroads themselves have an incentive to prevent smoke since terminals and buildings are rapidly deteriorated by it; however, this latter [illegible] imperfect combustion.

The question of smoke prevention [illegible] great owing to the limited space in a [illegible] years many devices have been constructed to attain the smokeless loco- [illegible] must be borne in mind that the problem is not only to prevent the visible smoke, but also to prevent the waste of flue gases.

A table showing the losses due to excess air is here given. It clearly shows of what importance this question is. In fact, one of the leading railroads has regulated its fuel combustion by watching the air supply and regulating it by means of the vacuum in ash pan.

SMOKE GENERATION IN DIFFERENT FUELS.

Bituminous coal has a carbon content from 66 to 80 per cent; (H.) hydrogen 3 to 5 per cent; (O.) oxygen 4 to 21 per cent.; (N.) nitrogen 1 to 2 per cent.; (S.) sulphur 1.5 to 4.5 per cent.; and ash content from 5 to 21 per cent. Bituminous coal is easier to burn than anthracite, but burns with a heavy, long, sooty flame and requires large grate area. It is sometimes mixed

LOSSES IN FUEL DUE TO EXCESSIVE AIR

Remarks	Per cent. of CO_2 in flue gas. (1)	Amount of air per lb. of coal for perfect combustion [illegible] representing theoretical amount of 12.5 lbs. (2)	Pounds of air unused and heated to 518° F. and wasted per lb. of coal. (3)	[illegible] ft. of unused air heated to 518° and wasted per lb. of coal. (4)	Per cent. of heat lost [illegible] in flue. (5)
	4	4.7	42.5	530	40.5
Poor	5	3.8	31 25	392	32.5
	6	3.2	23.75	296.1	27.2
	7	2.7	18.55	232	23.2
obtained under ordinary conditions	[illegible]	2.4	12.45	155.1	20.2
	[illegible]	2.1	9.35	116.5	18.1
	10	1.9	7.55	94.5	16.2
	11	1.7	6.95	82	14.8
obtained under first class [illegible]	12	1.6	3.75	[illegible]	13.5
	1[illegible]	1.5	1.93	24.1	12.4
	14	1.4	0.2[illegible]	[illegible]	11.3
	1[illegible]	1.3*	0	0	10.7

*In this case 1.3 times theoretical air is used, which is generally aimed [illegible] or 16.25 lbs. of air.

†Loss in flue [illegible] following [illegible] simple equation: Flue loss

$$[illegible] \left(\frac{T - t}{K}\right)$$

(270 C.) = T = [illegible] gases in Centigrade.
(23 C.) = t = temperature of air supply in Centigrade.
K = per cent. of CO_2 in flue gas.

Note.—518° F. taken as average temperature of flue or smoke box gases and temperature of air supply 750° F.

with charcoal in proportion 2 to 1 on Austrian railroads and fired with good results in lessening the smoke generated.

Anthracite coal burns with a short smokeless flame, and its general contents are: carbon 75 to 93 per cent.; 4 to 5 per cent. H.; 3 to 19 per cent. O.; 2 to 1 per cent. N.; sulphur is at times present.

The best fuel for locomotive firing is one with long flames and one that does not crank up in burning nor clinker. By a judicious mixing of different kinds of coal one is able to obtain such a fuel, as will be pointed out later.

Coke—made through heating hard coal, namely semi-bituminous, under small air supply, a fuel that prevents smoke is assured, which cities, terminals and long tunnels should use. The volatile matter of the coal is burned through the coking process. Coke burns with a short flame and has a high heating value. General content—93 per cent. C., .3 to .5 per cent. H., 2 per cent. O.

For some time bituminous briquettes have been used to advantage, but owing to the presence of pitch binder create a smoke.

The complete elimination of smoke is obtained by using petroleum oil, such oils as tar oils or gas oil; and also by well-known methods of smoke prevention, i. e., by firing in small quantities at short intervals of time, or to have the coal coked before reaching the hottest part of the fire, the underfeed stoker having the latter end in view.

[illegible]

In determining the application of coal for locomotive use of the B. T. U. value does not play an important part. A coal with low B. T. U. value can compete with a high B. T. U. coal where the greater amount burned does not increase the cost of the total operation, as is the general condition in locomotive firing.

Most railroads in Europe do not specify any B. T. U. value, but do specify the limits of ash; however, the heating value or pounds of steam each pound of coal can generate is determined from time to time because the value of the coal depends on this.

The majority of German roads which use coal from mines yielding a coal of practically constant chemical elements limit themselves to special test of steaming qualities when coal is procured from a new mine.

The St. Gotthard railroad or united railroad of Switzerland—has a special testing laboratory at Zurich to which the various roads send 5 Kg. coal daily for tests, this quantity being taken from the pile according to the specification.

This system specifies that the heating value must be 7,400 calories, at least, anthracite; briquettes 7,600 calories; and limit the ash contents to 9 per cent. for coal and 8 per cent. for briquettes. Fifty Kg. of briquettes in sizes of 0.5 Kg. are put to the cohesion test, which consists in rolling them in a cylindrical drum, 32.4 ins. in diameter and 39 ins. long, the drum rotating about its axis at 25 revolutions per minute and the contents then shifted to determine the amount of slack. The heating value is determined from these tested briquettes, the percentage of slack being called the coefficient of adhesion.

The French railroads take 1 Kg. of coal as a sample out of every ten tons; then out of 40 such test samples, that is for 400 tons, by means of the usual quartering methods, a final sample of 500 to 600 grams is taken. From this sample three smaller samples of 50 grams are taken and put in three boxes and ground up fine. The first is tested in the laboratory, the second is given to the coal dealer and the third kept for reference.

The average ash content is taken from the series of results. If this percentage goes above the average of 14 per cent., the dealer's price is cut 0.3 franks for every per cent. above 14. If the amount is less than 12 per cent., the price is cut down 0.2 franks per cent. This holds true for per cents. between 14 and 24. If the percentage goes over this limit, the coal can be returned to the dealer.

In a similar manner from every car of briquettes a piece is taken for test. Out of the whole sample from each supply of 400 tons about 60 Kg. of briquettes are sawed in pieces weighing 0.5 Kg. each and then tested for their cohesion factor. After so testing three 50-gram samples are taken finely ground and tested out as in the case of coal. In the main laboratory a piece is heated to 100° C. and its ash content and volatile content determined.

If the test shows an ash content less than 9 per cent. and volatile matter at least 16 per cent., the price per ton is raised to the dealer for a difference of 0.01 per cent. 0.004 franks raise is made.

For every 0.01 per cent. that the ash content goes over 10 per cent. the price is decreased 0.005 franks per ton.

In briquettes the cohesion coefficient must be at least 55 per cent.; for every per cent. less than 55 per cent. 0.15 franks is taken off, and for every per cent. less than 45 per cent. 0.25 franks is added. Briquettes to be of less than 40 per cent. cohesion factor, ash content not over 12 per cent., and volatile content more than 22 per cent. or not less than 16 per cent. can be returned to the dealer.

The northern railroad of France, where the coal is always taken from same mine, makes tests when it is discovered that there is a radical alteration in the heating value or a new kind of coal comes in use. Then the regular laboratory test is made to determine the water, volatile and ash content, the kind of slag if any, the coking properties, and the heating value. Supplementing this tests are made on runs with trains of different grades, observations being taken of the intensity of combustion per square foot of grate, as well as the steaming capacity and the amount and kind of ash or clinker determined.

These experiments took time, but it was found in the end that the time consumed was of real value in arriving at exact data in regard to these important details.

The system does not make any special qualification as to characteristics of coal, and use many different kinds of coal, from the lignites of 10 per cent. to bituminous coal with 40 per cent. volatile matter. They make a mixture of the various kinds of coal; this mixture consists of 30 per cent. run of mine coal and 70 per cent. anthracite and has an average percentage of volatile ingredients of 20 per cent.

On the eastern railroad of France, after the usual laboratory tests as to the characteristics of the coal have been made, a sample supply of 30 to 200 tons either used alone or mixed with a known kind of coal is used to fire a test, locomotive run. After the first test, tests are made of short or long duration on several engines. In case of a favorable result of these tests another series of tests are made with a like number of locomotives using a fuel of known properties. The locomotives and firemen are carefully picked out and after two to four weeks a decision is reached as to which fuel should be used.

In the state railroads of Hungary the coal after usual laboratory test and practical steaming capacity test at slow speed has been made a so-called standing test is made. The same locomotive which was used in the test run has its valves removed and the same amount of coal burned as during the test run, and then determined at what vacuum is required to maintain the rate of combustion necessary.

In conclusion it would seem that, with a fuel having an average volatile ingredient of 20 per cent. and fired under the "little and often" principle in combination with a brick arch and extended firebox, the smokeless locomotive might be obtained, or as near an approach to it as can be expected under the conditions existing in twentieth century locomotive construction.

Improved Vise Clamps

By WILLIAM DURANT, Somerville, Mass.

[illegible] handy device for holding small vise work. No extended description is necessary. Sim- [illegible] clamp in the jaws of a vise then tighten the work between the jaws of the clamp. For injector repairs, or work such as holding a pipe, the toothed jaws shown are useful. These jaws may be cut in the clamps, shown at A, or they may be made of tempered steel, inserted, shown in clamp B. The two clamps are practically duplicate, and can be made of machine steel, case-hardened. The slotted guides are secured by rivets, flush with the top sides of the clamps which are planed, also by one-fourth machine screws, allowing quick opening and closing. For the bench man who has pride in saving [illegible] brass work the device will be found of much [illegible]

DETAILS OF IMPROVED VISE CLAMPS.

The Defects in Shoes and Wedges

Improper Attention the Real Cause

By C. PENDLETON, Foreman of Engines, Washington & Old Dominion Railway

I have read with interest the article in [illegible] LOCOMOTIVE ENGINEERING, by Mr. Scheetz, of Shamokin, Pa., having reference to defects in shoes and wedges. I differ from him, in that the different supposed defects mentioned in his article are defects in the shoes and wedges, and are not defects in the shoes and wedges at all, but are due to improper attention being given to the running or shop repairs of the engines.

Where he attributes the varying hard- [illegible] the cause of not being able to keep the drivers square and in tram, by causing uneven wear, it is easier to obtain a clear, clean casting of cast iron than it is of steel, at a cheaper cost, owing to the fact that enough allowance is made in the casting [illegible] small as compared with what that of steel would be. Also, the cost of machining the cast iron is very small compared with that of machining steel.

It has been my understanding for several years that the reason of using cast iron for shoes and wedges is to replace the wear, that does take place naturally, and also the unnatural wear, at as small cost as possible. The first cost being small as compared with steel, and on account of being softer than the material [illegible] 97 per cent of the wear from natural and other causes. Thus the wear can be replaced by using cast iron cheaply, where if steel shoes and wedges were used it would mean a worn box in shoe and wedge way equal to the wear on shoes and wedges, which can be readily seen is not at all desirable. The wear also differs on the different wheels and is not due so much, I think, to defects in the castings of the shoes and wedges as to improper attention being given to the writing up of work reports by the different engineers, especially in pool service, the wedge work done by the engineers, and the work done to correct defects as shown in the work reports by the mechanics in the roundhouses at terminal or division points.

As to the fact of the bottom part of the wedge pulling out, this is very seldom if ever the case under wedge design of the past ten years, and if it does happen is due to improper design of the wedge bolt position, in so far as the hole is concerned than to defective casting. In all cases coming under my observation, which are very numerous, it has always been the case that the head of the wedge bolt [illegible]

The breaking of the flanges on the shoes and wedges is not due to defective castings so much, I think, if at all, as to badly worn pedestal jaws and engines having excessive lateral in the driving wheels, usually excessive lateral.

The tremendous blows struck when the engine is passing over what is called the center instead of showing defective compressibility of the casting by it being battered out of shape, shows the effect of improper attention being paid to the engines in adjusting the shoes and wedges to take up natural wear. The results of which could be entirely eliminated by proper adjustment of the wedges, which should have an inspection every 15 days, whether reported as being in bad condition by the engineer or not, keeping in mind the fact that the brunt of the natural wear of the parts of the engine falls on the shoes and wedges, as well as the rod brasses.

Where Mr. Scheetz contends that the friction in the shoes and wedges is not purely sliding friction, but pounding, he would leave the impressing that it is pounding alone. I think the readers will agree with me here, that if proper means are used to take up the sliding friction, which should be the only real friction in the shoes and wedges, that there would be no pounding present. If the shoes and wedges are kept adjusted properly there should be no movement to cause excessive friction other than the movement of the boxes up and down, which is sliding friction. The lost motion arising from poor adjustment causes the pounding and should not be credited to the casting as being defective.

In so far as the use of brass for shoes and wedges goes the cost is absolutely prohibitive, although good results have been obtained in some cases by using brass filling on the driving boxes to work against the cast iron shoes and wedges. This has not met with general approval.

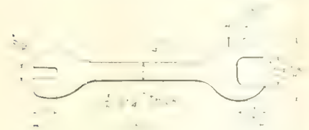
In case the engines are permitted to run in such condition to batter out of shape the shoes and wedges, it would still be better to use cast iron than steel, for if steel was used it would spread out more than the cast iron and the burrs resulting would cause excessive wear on the shoe and wedge way sides of the driving boxes, and in most cases on long fast runs would result in what is termed stuck wedges.

The wear caused in the shoe and wedge way of the box in the wearing off or cutting down the burrs on the shoes and wedges, if of steel, would in most cases mean a new pattern for both shoes and wedges when the engine goes in for a general overhauling as the shoe and wedge way in the box would have to be planed out laterally, as well as on the face to obtain good bearing surface, for the shoes and wedges which would necessitate a wider pattern of both shoe and wedge. This wear on the box is not present to sufficient extent to be very noticeable, or to be paid attention to in usual run of locomotive repair shops, where the cast iron shoe and wedge is used, as the wear comes on the shoe and wedge practically altogether. When the cast iron shoe and wedge is used it is a very unusual thing to plane out the shoe and wedge way of the driving boxes laterally if it is ever done before the driving boxes are scrapped.

Combination Wrench for Repair Work on Westinghouse Air Pump Governor Heads

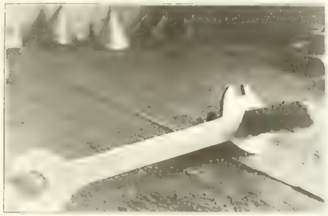
By F. W. BENTLEY, Jr., Missouri Valley, Iowa

The sketch and photographs below are descriptive of a light, simple and inexpensive combination wrench for work on air pump governor heads. The various openings of the wrench accommodate



every joint and part on the head for which a wrench is necessary. The smaller end takes the hexagon portion below the diaphragm body by which it is removed from the air cylinder cap or the siamese fitting. Owing to the construction of the diaphragm body it is often impossible to get anything but a special wrench to do the work in removing it, as the threads are often firmly set in those of the cap or siamese. The other or double end ac-

commodates the regulating nut, regulating nut cap and the No. 31 union nut. For roundhouse air work the wrench is very handy and convenient.



Air Pump Repairs

By J. H. HAHN, Savannah, Ga.

In overhauling top heads for Westinghouse 9½-inch air pumps it is often necessary to discard the reversing valve chamber bushing, account of same having a shoulder worn where the reversing bushings can be prolonged for three shoppings or overhaulings by reaming them with the device illustrated by the accompanying drawings.

After a standard size bushing has been

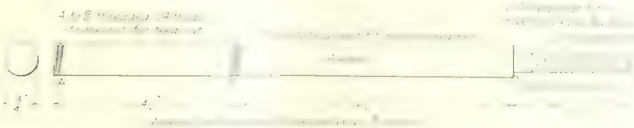


FIG.

valve works in the bush. The practice of removing and replacing these bushings is quite an expensive operation and often results in the top head being cracked by the bushing fitting too tight in the top head. The practice of renewing these in service long enough to have become worn too large for standard reversing valve, or if a shoulder has been worn in the bush, the dowel that holds reversing valve in place is removed with a punch and the bushing reamed, using the arbor

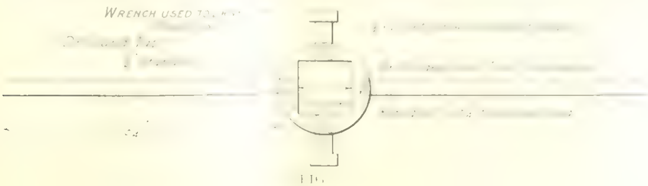


FIG.

shown in Fig. 1, which is entered in lower portion of reversing valve bush and the washer and a nut is used to hold arbor stationary during the operation. Next the 1 13/32-inch reamer is placed on the [illegible] a bushing measuring [illegible] inches, outside diameter, is placed on the arbor, a driving nut is put in place on the arbor, the wrench, Fig. 2, is used to drive the nut, which in turn forces the reamer [illegible]

The 1 13/32-inch reamer is replaced by 1 7/16-inch reamer and bushing, which must also be 1 7/16-inch, outside diameter, and this reamer is run down 1 1/16-inch from face of top head, where reversing valve chamber cap nut makes a joint, or 1/16 inch above top edge of port F in reversing valve chamber bush, this prevents the reversing valve from wearing a shoulder in the bush.

The Westinghouse Air Brake Co. will furnish catalogue numbers for ordering reversing valves 1/32-inch and 1/16-inch above standard sizes to be used in reamed bushings.

The Shell reamers made by Pratt & Whitney and shown on page 138 of their catalogue No. 7, are used by the writer, and in ordering the reamers state sizes, viz., 1 13/32-inch, 1 15/32-inch, also state for cutting cast iron and to be used on ¾-inch straight arbor.

Two bushings are made, 1 13/32-inch and the other 1 7/16-inch in diameter, two of 1 7/16-inch, and the other 1 15 32-inch, are made.

This tool can be made in the average railroad repair shop, and will greatly facilitate in the economical repair and maintenance of the steam portion of 9½-inch Westinghouse Air Pumps.

Human Fallibility.

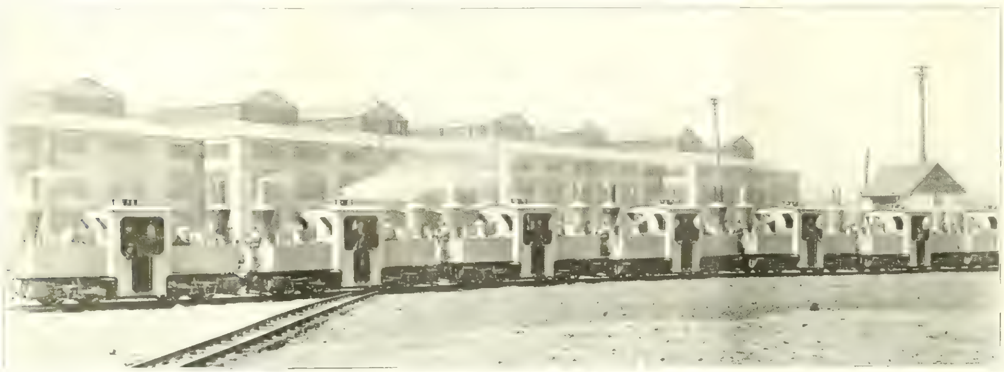
It may be said that the whole aim in recent progress toward the elimination of preventable accidents on railroads is to reduce the element of human fallibility to the lowest possible minimum. That, says the St. Louis *Post-Dispatch*, is the purpose of the "safety first" movement that is winning substantial triumphs in railroad operation. It is the especial object of many ingenious automatic devices of decided utility in the protection of life.

As the strain on men occupying the positions of larger responsibility in the operating force is diminished by approved laws, efficient protective apparatus and observance of tested precautions of various sorts, the likelihood of blundering is ma- [illegible] quency of the once common smashups in which from twenty to forty persons were killed has agreeably impressed newspaper readers. The total disappearance of serious accidents under normal operating conditions, leaving in the record only those occurring under infrequent and unfavorable conditions, would strikingly demonstrate the value of "safety first."

One Hundred Pechot Type of Locomotives

For the French Government

One hundred narrow gauge locomotives [illegible] 0-4-4-0 wheel arrangement, have recently been built by The Baldwin Locomotive Works for the French Government. These engines, named after their designer, are generally similar in construction to the Fairlie type.



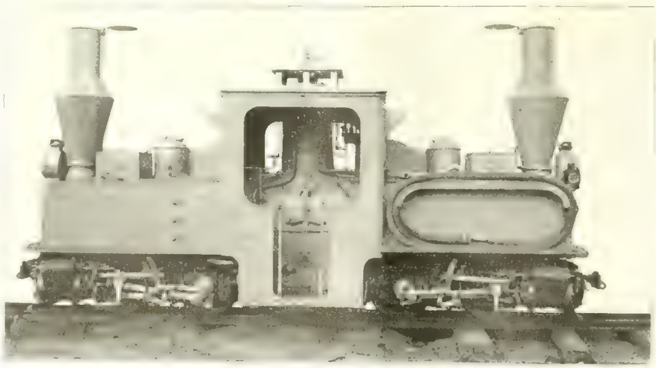
[illegible] TYPE OF LOCOMOTIVES FOR FRANCE. BALDWIN LOCOMOTIVE WORKS, BUILDERS.

The locomotive is carried on two steam trucks or "bogies," and is provided with a boiler having two barrels, or cylindrical sections, and two fireboxes. The latter are placed in a single outside shell, which is located between the bogies. Such a locomotive is exceedingly flexible, but has certain complicated features which have always been considered undesirable in American practice; and previous attempts to introduce engines of this type in the United States have proved unsuccessful. Their use abroad has been confined to roads where curves are frequent and [illegible] unusual flexibility.

[illegible] of brass. Each boiler barrel contains a [illegible] the locomotive. The steam dome is placed above the fireboxes. It contains two throttle valves, one of which communicates with the cylinders of each bogie. Steam is normally admitted to all four cylinders, but, if desired, the locomotive [illegible] The boiler barrels are supported by saddles, placed directly over the bogie center pins, while the firebox shell is supported by two plate frames, which are riveted to the saddles. The boiler simply rests on the saddles, without being attached to them, so that provision is made for ex- [illegible]

through openings in the bottom, and pass down through the bogie center pins; hence the ball joint in each pipe can be arranged to coincide with the center on which the bogie swivels. The steam distribution is controlled by balanced slide valves, which are driven by Walschaerts motion. Reversing is effected by means of a hand lever.

The cab is located in the center of the locomotive, and the water supply is carried in four tanks, placed beside the boiler barrels. The two tanks on the firemen's side are shorter than the others,



[illegible] TYPE [illegible] FOR THE FRENCH GOVERNMENT.

so that space is provided, adjacent [illegible] a side door and is fired independently of the other.

The American-made equipment includes injectors, whistle, safety-valves, lubricator, steam-gauges, headlights, and cab and signal lamps. The locomotives are fitted with hand screw-brakes and with draw-bars of the radial type.

These locomotives were erected at the Eddystone plant, and were subjected to severe tests, each being run under steam for approximately half a day. A special track was built for testing purposes. Each locomotive was shipped complete in one case. The stacks and a few small fittings were removed, but were boxed with the locomotive, so that very little erecting work was necessary on arrival at destination. Considering the fact that these locomotives were built throughout to metric measurements, and were of most unusual design, a quick record for delivery was made, as the order was received on February 1 and the last engine shipped on April 24.

The principal dimensions of these locomotives are given herewith.

Gauge, 0 m 600; cylinders [illegible], 0 m 175 × 0 m 240; valves, balanced slide.

Boiler—Type, wagon-top; diameter, 0 m 632; thickness of sheets, 0 m 009; working pressure, 12 kg per cm^2;

fuel, coal; crown sheet staying, crown-bar.

Fireboxes (2)—Material, copper; length, each, 0 m 415; width, 0 m 576; depth, front, 0 m 870; depth, back, 0 m 820; thickness of sheets, sides, 0 m 012; thickness of sheets, back, 0 m 012; thickness of sheets, crown, 0 m 012; thickness of sheets, tube, 0 m 020 and 0 m 012.

Water space—Front, 0 m 050; sides, 0 m 050; middle, 0 m 050.

Tubes—Material, brass; thickness, 0 m 002; number, 96; diameter, 0 m 045; length, 1 m 740.

Heating surface—Firebox, 3 m² 762; tubes, 23 m² 225; total, 26 m² 987; grate area, 0 m² 474.

Driving wheels—Diameter, outside, 0 m 650; diameter, center, 0 m 560; journals, diameter, 0 m 120; journals, length, 0 m 092.

Wheel base—Driving, 2 m 300; rigid, 0 m 900; total engine, 2 m 300.

Weight—On driving wheels, 12,790 kg.; total engine, 12,790 kg.

BOILERS FOR THE PE[illegible] LOCOMOTIVES IN COURSE OF CONSTRUCTION

Tank capacity, 1,514 litres; fuel capacity, 400 kg.; service, freight.

It will be remembered that in the metric system in which the measurements are presented, one inch is equal to 25.4 millimetres, and one foot is therefore equal to 304.8 millimetres, or .3048 metre. Or one millimetre is equal to 0.03937 inch, and one metre is equal to 39.370113 inches. Hence the gauge of the track for which the locomotives are adapted is 23.622 inches nearly. The total length of the wheel base of this locomotive would be 90.55 inches.

British Columbia Railway Building.

In anticipation of the completion of the Edmonton, Dunvegan & British Columbia Railway this year representations are being made to the Provincial Government by settlers resident in the western section of the Peace River district for roads and ferries to connect with the new line at Pousse Coupe, the end of the line [illegible] the Provinces of Alberta and British Columbia. There are about [illegible] settlers in the Peace River district who are urging the construction of a branch road through that section of the Province. The country is splendidly adapted for farming, large tracts of fine open prairie being available for settlement. The Edmonton, Dunvegan & British Columbia line has now been built to Round Lake, 150 miles from the British Columbia boundary, and grading has been finished as far as Smoky River, another 30 miles west. The construction of a trunk highway from Pousse Coupe to Hudsons Hope, a distance of 75 miles, is desired, with a service of ferries to afford through communication with the railway when completed.

Safety Gates of the Baltimore & Ohio.

Safety gates at highway crossings of the Baltimore & Ohio railroad tracks hereafter will be painted white so that the most distinctive warning may be afforded travelers on State highways and other thoroughfares in minimizing the danger of accidents. Notice concerning the adoption of a standard color for crossing gates has been issued to the forces throughout the territory served by this railroad in connection with its campaign conducted systematically for some time past of employing watchmen in uniforms to patrol many busy highway crossings and posting warning signs to protect the public. That nothing should be left undone in this direction, track walkers, laborers and other employees have been drilled in urging upon the public utmost caution in using highway crossings and requesting pedestrians to refrain from using the right [illegible] fare.

Railroad Construction in Russia.

An important railroad is being built northward from Petrograd [illegible] on the Arctic Ocean near the Norwegian frontier, about 500 miles west of Archangel, on a portion of the Arctic coast line, reached by the end of the Gulf Stream, which makes the climate here much milder than at Archangel. A port will be created here that should never become icebound, as Archangel is in winter. This railway can be built during the progress of the war, as the Finns, who are not liable to military service outside of Finland, are available. The road is to pass through Petrozavodsk, on Lake Onega, with the southern terminus at Ekatherinenhaven, probably 750 to 800 miles from Petrograd. The distance would probably not be more than 150 to 200 miles farther than Archangel is from Petrograd. Rapid expansion in general building work is expected in Russia, and simultaneously the extension and building of numerous railroad lines.

Operation of Canadian Railways.

The operating mileage of Canadian railroads increased 1,491 miles for the year ended June 30, 1914, making the total mileage of single track 30,794 miles, or, including second track, yards, and sidings, 40,605 miles. The statistics show that 471,515 more passengers were carried and 5,598,721 tons less of freight hauled than in the fiscal year 1912-13. The number of passengers carried last year was 46,702,280, and tons of freight hauled 101,393,989. The gross earnings of the roads amounted to $243,083,539, a decrease of $13,619,164; but there was a decrease of $3,036,431 in operating expenses. Cash aid to railroads last year amounted to $16,106,319 (the Dominion, $15,583,059; the Provinces, $523,260), the largest cash aid in any year in the history of Canadian railways.

Australia Orders Locomotives.

On the recommendation of the Minister for Home Affairs, the Federal Cabinet decided to place an order with Messrs. Wallace, of Maryborough, Queensland, an order for twenty locomotives. They are to be delivered for use of the trans-Australian railway. Ten are to be delivered at Port Augusta; the price for each is $37,042. The other ten are to be delivered at Kalgoorlie; the price for each being $35,355. Five other locomotives will be constructed by Martin & Co., Gawlor, South Australia.

[illegible]

How strangely men act! They will not praise those who are living at the same time and living with themselves; but to be praised by posterity, by those whom they have never seen or ever will see, this they set much value on. But this is very much the same as if thou shouldst be grieved because—those who have lived before thee did not praise thee.

Department of Questions and Answers

Blocking Disabled Valves.

[illegible] Some [illegible] the valve on disabled side be secured in such a position as to provide lubrication for the cylinder. [illegible] whether [illegible] and [illegible] the port [illegible] cylinder. [illegible] is my understanding is correct and if it works out successfully in practice. A. The general practice is to block the valve centrally, so that no steam can enter the cylinder. In [illegible] should be [illegible] to admit of a limited supply of oil which would lubricate the piston for a considerable amount of travel. In the case of blocking the valve in such a position that a small port opening is left for the purpose of admitting steam, it is good practice to remove the cylinder cock at the end where the [illegible] may escape readily not only to avoid compression, but as the jarring of the engine may serve to move the valve and possibly admit more steam than is desirable for the purpose of lubrication. The means to be taken in such cases depends to a great extent on the distance that it may be necessary [illegible] has occurred, and whether it may be convenient [illegible] the [illegible] cylinder.

Motion of Car Wheels.

[illegible] in regard to the velocity of car or other [illegible] wheel travel faster on the top than on the bottom [illegible] What the cause of the difference, if any? A.—Whatever the diameter of the wheel may [illegible] twice the speed of that of the car. Everything in the periphery of the wheel of a [illegible] moving around the circle at ten miles an hour, while the center of the axle itself [illegible] ing at the rate of ten miles an hour in a forward direction, around the axle, while the axle is also moving forward ten miles an hour, and the two ten-mile movements [illegible] as the rate at which the point at the top [illegible] running around the circle at the rate of [illegible] car is moving. Thus, as that point in the wheel is going backward at ten miles an hour, while the axle to which it is attached is going forward ten miles an hour, the motions forward and backward counteract each other, so that the point actually touching the ground at any moment is actually standing still. If it is not, it must be slipping. The diameter of the wheel being twice the radius, the top of the wheel must move forward at twice the speed of the center, that is twenty miles per hour. Against this, it may be urged that the wheel being in one piece it is impossible for one part to be at rest and the other moving at twenty miles per hour; but a photograph of a carriage wheel will show the spokes sharp and distinct at the bottom and blurred at the top, showing that the motion through space is variable.

The Jitney.

J. S., Oakland, Cal., asks: What is the origin of the jitney, and does it serve any good purpose in the way of transportation? A.—The jitney, so-called, has its origin in the present depressed state of business. Many men who have lived up to or over the limit of their means, finding themselves out of employment and having a small auto on their hands, which nobody wants to buy, have gone into the transportation or jitney business, and are simply doing something for themselves and, in many cases, earning enough to enable them to get something to eat. In other words, the jitney driver is living on his capital, or perhaps the capital of some one else. Its effect upon the income of many transportation companies is already particularly marked, and if the public continues to support the jitney the street railways will disappear.

Cost Per Mile of New Railroad.

[illegible] What would be the cost per mile of a new railroad over a fairly level or slightly undulating country such as the Middle West? A.—Estimates have been furnished of the expense of railroad construction on the plains of Texas, exclusive of real estate, stations, equipment and signals, averaging $19,649 per mile. On the slightly undulating ground of Ohio the cost averaged $40,000 per mile. Add to these sums $10,000 per mile for equipment and $10,000 for right of way, and a fair estimate may be arrived at. For double track, the cost of construction ranged from $50,000 per mile in New York to $154,000 in West [illegible]

Horse Power and Absolute Zero.

W. H. B., Leeds, England, asks: What is meant by horse power hour and absolute zero? A.—The term horse power is the unit by which the work performed by engines and machinery was originally measured, and was based on the comparative calculation that the early steam engine men made, having frequently to replace the labor in pumping by horses. Thirty-three thousand foot-pound of work per minute was established by Watt, the inventor of the modern steam engine, as the amount of work that a horse could accomplish, and if this estimate is of any value it may readily be multiplied by 60, and the result would be the horse power hour. That is one horse power consists in raising 33,000 pounds 60 feet in one hour.

In regard to the term absolute zero it may be briefly reckoned as the logical beginning of a thermometric scale. The oldest system, that of Fahrenheit, dates from 1724, and after various markings of the expansion of mercury, at the suggestion of the Danish astronomer Roemer, 0 degrees was placed as absolute zero, 32 degrees as the point at which water freezes, and 212 degrees as the point at which water boils at common sea level. This is the common reckoning in the United States as well as in the British Empire.

Grease Cup and Water Cooling.

B. F., Santa Rosa, Cal., writes: Kindly explain the principle of the grease cup, and what is the objection to using water on a hot pin when grease is used? A.—The principle upon which the grease cup depends for its operation is that of hydraulics; it is pressure and compression, coupled with expansion. The cup is filled with grease, then the cover is applied and the plug screwed down, subjecting the grease to considerable pressure, forcing same through the small hole on the lower part of the cup and to the pin. When the plug is screwed down the grease in the cup is slightly compressed, and the expansion which takes place in the grease as pressure is gradually reduced by the consumption of the lubricant on the pin is sufficient to maintain a slight flow of grease for some considerable time. As a general rule, water should not be used on hot pins. When it is used it should be only as a last resort and under these conditions could be used the same in connection with grease cups as with ordinary oil. The sudden cooling with water distorts the brasses and straps, and increases the liability to increased heating or fracture.

Mechanical and Scientific Notes

Hardening a Scratch Awl.

A good method of hardening the point of a scriber is to heat the point over an alcohol lamp, leaving the extreme point out of the flame to avoid the danger of overheating. Hold a thin piece of ordinary soap in the hand over a cup of water, and when the scriber has reached a cherry red color, push it down through the soap into the water below. The temper should then be drawn to a dark straw.

Welding Iron and Steel.

In welding steel to iron, fork the iron and insert the steel. As the iron requires to be at a higher degree of temperature than the steel, insert the iron earlier in the fire. In very fine work, some smiths use separate fires, charcoal for the steel and coke for the iron. Borax to be used for welding should first be melted, and then ground up. A good welding mixture is borax, eight pounds; salammoniac, one pound; yellow prussiate of potash, one pound. Dissolve all together in water, and then evaporate them to dryness at a gentle heat, stirring constantly.

Reamers from Old Drills.

Old twist-drills may be converted into taper reamers by softening, turning to the required taper, thus turning to good account old drills, which, in consequence of the increasing use of high-speed twist-drills, rapidly tend to become merely scrap. The direction of revolution of the drilling-machine spindle must be reversed, and the grinding, backing-off, or relieving of the reamer correspondingly altered, so as to obviate the digging of the flutes of the drill. Reamers made in this way are also useful for reaming holes into line on general plating work.

Truing Oilstones.

Take a piece of soft pine board of any thickness, about 8 ins. wide and 3 or 4 ft. long. Lay it on a bench and fasten it with a handscrew or other clamp. Put on some clean, sharp sand screened about as fine as that used for plastering work. Use no water, and rub the stone back and forward over the board in sand. This will give a flat surface to the stone in a short time. Care should be taken in moving the stone on straight lines, so as not to give the stone a warped surface. The board can be saved by boring a hole in one end and hanging up out of the way. If a fine surface is wanted, a finer grade of sand or sandpaper may be used to finish with.

Imitating Casehardening.

When it is desirable to darken polished or ground parts to imitate casehardening, the result may be readily a[illegible] by using one part nitric acid and twenty parts water. Immerse the article to be treated about twenty seconds and then rinse with clear water.

Drilling Glass Without Danger of Breakage.

When attempts are made to drill holes in glass, cracking nearly always results, yet glass can be drilled without danger of breakage. To do so, put a piece of brass tubing in the drill spindle, the outside of the tube being equal to the size of the hole desired. Revolve rapidly and feed with emery and water.

Luminous Paint.

Take oyster shells, wash and clean them well in warm water, then put them into a fire for half an hour, then take them out. When quite cool, pound them fine, taking away the gray parts, as they are of no use; put the powder into a crucible in alternate layers with flowers of sulphur; put on the lid, seal up with a paste of sand and beer; when dry place on the fire and bake for one hour; when cold take off the cover; separate all gray parts; mix into a thin paint with fine varnish. Previous to applying, the article to be painted to have two coats of white lead and turpentine, to form a body-ground for the luminant.

Hardening Tools.

Cover the cutting-edge of the cutter or the design on the face of the die with a thick coating of paste, made from ground bone-dust and crude oil. Heat the work slowly until it becomes cherry red. Use charcoal, and bank the fire completely over the work. When sufficiently heated, cool immediately, until the article can be safely taken hold of with the bare hand, then shut off the blast from the fire, and again heat the tool until sawdust thrown upon it will burn. The work should be placed back into the fire as soon as possible after the first heating and cooling to prevent cracking or checking of the steel. The die or cutter can then be polished, and the temper drawn without any danger. With small tools it is good practice when first heating to rub soap over the face of the cutter. The potash in the soap will eat the grease or other impurities from the metal and cause it to be perfectly white after it is cold. The temper may then be drawn in the usual way.

It need hardly be stated that there are endless ways and means of hardening cutting tools, each artisan, seemingly having a method of his own. But the above has met the approval of a large number of skilled workmen in different localities.

Locomotive Models in the Smithsonian Institution, Washington, D. C.

A model of the first locomotive that ran on rails and which was constructed by Richard Trevithick in Wales in 1803, is to be seen in the National Museum, as is also the model of the engine employed by John Stevens in 1825, and his original tubular boiler. Other models illustrate nearly all the types which began to put in their appearance soon after 1828, when the "Stourbridge Lion" was built in England and shipped to America, where it was the first engine to run on full-sized rails. The Museum possesses not only the model of this historic engine, but the original engine itself. The other original full-sized locomotive to be seen in the Museum is the "John Bull," built by George Stephenson & Sons, of England, and shipped to America for use in 1831 on the Camden & Amboy Railroad. It is interesting to recall that this old relic of early railroading in America made a round trip under its own steam in 1893 from New York to Chicago, where it was exhibited at the World's Columbian Exposition.

Among the models of early and historic locomotives are: George Stephenson's "Rocket," built in 1829; The B. & O. engine "Tom Thumb," built by Peter Cooper in 1829; the grasshopper type engine "Arabian" of 1831; the "Best Friend," used in 1830-31; Baldwin's "Old Ironsides," constructed in 1832; the "Sandusky," built in 1837, and models of engines made by Asa Whitney in 1840, and G. A. Nicholls in 1848. Besides the two locomotives and the numerous engine models there are in the exhibit, coach and car models, sections of rails, spikes, wheels and models and parts of valves, pistons and other early patented accessories pertaining to locomotives and railroads, all of which go far toward completing an absorbing chapter of graphic history in connection with this interesting and important commercial development.

The Impact of Flat Spots on Car Wheels.

The impact resulting from flat spots on railroad wheels under different loads and at different speeds is being studied at a Western university by means of an instrument that records the force of the blow photographically. In these tests, which cover flat spots of various lengths, it has been found that a wheel with a flat spot 3 inches long strikes a blow of 104,000 pounds with the car going at 16 miles an hour and carrying a load of 20,000 pounds. Under similar conditions a [illegible]

[illegible] engineers wonder why rails are [illegible]

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Counterbalancing Locomotive Driving Wheels.

[illegible] Railway Master Mechanics' convention, is locomotive counterbalancing, of which Mr. [illegible] locomotives in order to produce a smoothly running engine at all speeds, has received amazing attention throughout the whole of the railway era and no exact [illegible] locomotives began hauling passenger [illegible] parent that unbalanced driving wheels [illegible] the train, and remedies were at once sought for. The first experiment made to devise a remedy was carried out by George Heaton on the Liverpool & Manchester Railway. Up to 1834 only the revolving weights were considered, but in that year J. G. Bodner patented the application of two pistons of the same stroke to work in each cylinder, operating upon a double crank on the axle in opposite directions; the avowed purpose being to make the disturbing action of one piston counterbalance that of the other, thus obtaining perfect equilibrium. These experiments were succeeded by the introduction of four cylinder locomotives of various forms, the Shaw and the Ball locomotives having been at one time well known in the United States.

The first of these four cylinder locomotives was brought out by Mr. Wheallens in 1836, and eleven years later Mr. Haswell brought out a similar engine, which was operated in Austria for about 27 years, and was highly spoken of, but its performance did not justify the railway people in repeating the experiment, although its success probably led to the construction of the Shaw and the Ball engines in this country.

The problem of balancing the wheels of locomotives involves a calculation of the weight of cranks or crank-pins with their attached rods, crossheads and pistons, and applying a sufficient weight on the opposite side of the wheel from the crank to make up for the superincumbent weight of the crank attachment. Without such counterbalance a sort of eccentric motion would be given to the wheels, which all the acquired momentum of even the heaviest kind of locomotives could not completely overcome.

It would seem at the first glance that the problem would be simply to find out how much weight would be necessary to equalize the disturbing factors, but the fact is that it is the simplest part of the calculation. It must be remembered that the piston and the crosshead move in a straight line. The main and connecting rods describe varying paths. While the engine is running ahead the thrust of the main rods is downwards with the consequence that the weight upon the rails is somewhat increased, and when the thrust of the rods on the wheels is upwards, as is the case when the engine is running backwards, the tendency is to lift the wheels from the rails. Added to this is the centrifugal force of the side rods and the heavy end of the main rods, and in the case of locomotives equipped with the Stephenson valve gear, there is a small added disturbing factor in the weight of the eccentrics which lean toward their respective crank pins, increasing the amount of weight to be counterbalanced, and which in an attempt at an exact adjustment should also be taken into consideration.

It will thus be seen that in the simplest forms there are several problems to be dealt with. The balancing of the sheer weight of the various attachments is simple enough. An extra weight conveniently placed near the rim of the wheel opposite to the location of the crank, as we have stated, can be so justly balanced as to counteract or make up for the eccentricity caused by the opposing weight. The other disturbing factors are not easily overcome. To understand clearly what takes place at each reversal of the stroke of the piston, we shall presume that the piston has reached the forward end of the stroke. The movement of the piston up to this point has been to move the engine forward. Now the piston has to be made to move backward with a velocity from nothing to twenty feet or more a second, the crank literally having to drag the piston out of its position. This disturbance cannot do other than make the engine move by jumps, and the movement is further involved by the location of the cranks which are generally set at right angles to each other, or at 90 degs. apart. Continued experiments have demonstrated the fact that these accumulated disturbances may be almost completely overcome by increasing the weight in the rim of the wheel opposite to the crank or crank pin.

Reports on counterbalancing locomotive driving wheels have been repeatedly submitted to engineering organizations, some of them involving immense research and accurate labor. Among these the most exhaustive one was prepared by Mr. R. P. C. Sanderson for the Southern Railroad Club in 1894. The report, which is profusely illustrated, covers twenty-nine pages and makes highly studious reading, various aspiring flights being made into the realms of the differential integral calculus. Mr. Sanderson had received particulars of seventeen different rules for counterbalancing the driving wheels of locomotives as followed in the different countries where railways are operated. In this great diversity, together with errors of application of the rules, can be found the reason why some roads have had to reduce the excessive counterbalance in their locomotives to keep them from damaging the track, and others have had to add more counterbalance to keep the cars from being shaken off the engines.

Referring to the great diversity of rules Mr. Sanderson remarked: there is one cardinal principle which needs no demonstration or explanation to men worthy of being called mechanics, and that is that each pair of wheels, or better still, each wheel should be perfectly balanced within itself for all the rotating or revolving weights attached to the crank pin. In studying the seventeen different rules, the first difficulty encountered is how much of the main rod should be considered as revolving weight and how much as recip[illegible] take one-half

some two-thirds of the weight as revolving, and others take the actual weight of the back end as revolving weight. Naturally if the big end is considered as cut off from the body of the rod, this would be counted as revolving weight, if the front end was cut off it would trail back and forth forming reciprocating weights.

Scarcity of Mechanics in Britain.

From the complaints we are hearing reported all over the country of men out of work being supported by charity, it appears that our laboring classes are suffering severely, yet the immigration reports indicate that workmen from foreign countries keep continually coming to help swell the ranks of our unemployed. A very different condition of affairs appears to prevail in Great Britain.

Our Glasgow agent, Mr. A. Fraser Sinclair, writes a weekly letter to the Glasgow *Herald* on motoring. In a recent issue he discusses the shortage of skilled mechanics thus:

When paid drivers accept the shillings which the recruiting officers are so anxious to dispose of the clubs are doing their best to provide suitable substitutes. It may be wondered when those substitutes are described as qualified why they, as well as the men whom they replace, should not enlist. The fact is that there are plenty of men who are quite capable of doing all required about a motor car who are from some physical disability unfit for the hardships of active service. On the other hand, there are many men with a little knowledge who, in sympathetic employment, would in a very short time become expert drivers. Such men would then be ready to fill gaps at the front as necessity arose. Owners of motor cars who employ drivers should recognize that they owe a duty to the army. As a rule, they are people with a real stake in the country, something substantial and worth fighting for. The great majority of the millions who are offering their lives in the cause have no incentive beyond a sentiment—patriotism—and if working men are willing to give their lives for such reason, surely the well-to-do might cheerfully sacrifice their comfort by employing less skilful drivers and by giving some time to make these drivers efficient. The same reasons apply in the case of business houses. It may mean some inconvenience at first, but the skill necessary for mere driving is easily acquired, and when trouble is experienced there are experts for the work of putting to rights. What the War Office will find more trouble in securing at the present time is a supply of men with a knowledge of motor car mechanism and manufacture. It is stated that such men are in demand, but it is difficult to see where they are to come from. So hard pressed are the factories to keep up with Government requirements that thousands more of skilled mechanics could be employed in the Midlands alone. How, under such circumstances, it can be expected that men for the front can be provided is a puzzle. The output of war material must go on, and for that purpose all the qualified men in the country are needed. On the other hand, if it be imperative for the success of our arms that mechanics enlist for service on the continent their places might be filled by men from beyond the Atlantic. It would be expensive labor, but this is a struggle in which expense is not being considered. While it would very likely be a violation of the laws of neutrality for the British Government to ask for belligerent help from the United States, there should be no objection to asking for industrial assistance. Given suitable terms, crowds of men would gladly offer their services.

Business Outlook.

From reports collected from the presidents of the leading railroads in America, it is evident that there is already a marked improvement in the business outlook. About one-third reported improvement of a tangible kind and the remainder all gave assurances of a more hopeful spirit than has been felt in several years. The Pennsylvania heads the list with an appropriation of nearly thirty millions, which will be expended on betterments, renewals and new equipments during the present year on purchases already authorized. The Chicago & Northwestern is also soliciting extensive bids for new equipment. In New England and the Atlantic states generally the sentiment seems to be better, but the volume of business is not yet larger, but the general assurance is growing that a marked improvement will be noted before the end of the year. It may be taken for granted that the depression has passed its lowest ebb and that the upward trend, although not rapid is assured.

Cost of Steam and Electric Locomotives

The average cost per locomotive derived from a large number of records of steam locomotives in all classes of service has been found to be about 20 cents per mile, including fuel and supplies, maintenance, repairs, and engine house expenses. A similar figure for electric locomotives operating in and about New York City can be shown to be about 21 cents per mile, but when fixed charges are added, the comparison becomes 30 cents for steam locomotives and about 60 cents per unit for electric locomotives. A modern steam locomotive costs about $25,000, and an electric locomotive of the same capacity will cost about $45,000; and that is not all, the cost of the power stations, transmission lines, substations and working conductors must be added, which will bring the equivalent cost up to about $100,000. Hence there should be a large saving in operating costs to cover the increased fixed charges, or there must be some other good reason for incurring the additional expense. At the same time electrical transportation is very attractive to the traveling public; it is comfortable, clean and pleasant. A more general use of electricity will come when it is financially possible.

Engineering Efficiency of the British Navy.

The management and efficiency of the British navy has been the subject of much criticism and fault-finding by certain grumblers who talked as if the British navy was defective in every particular. A short time ago Naval Secretary Churchill, speaking in the House of Commons on the efficiency of the navy in a celebrated sea-fight, said:

"There is another remarkable feature of this action to which I should like to draw the attention of the house. I mean the steaming of our ships. All the vessels engaged in this action exceeded all their previous records without exception. I wonder if the house and the public appreciate what that means? Here is a squadron of the fleet which does not live in harbor, but is far away from its dockyards, and which during six months of war has been constantly at sea. All of a sudden the greatest trial is demanded of their engines, and they all excel all previous peace-time records. Can you conceive a more remarkable proof of the excellence of British machinery, of the glorious industry of the engine-room branch, or of the admirable system of repairs and refits by which the grand fleet is maintained from month to month, and can, if need be, be maintained from year to year in a state of ceaseless vigilance without exhaustion? Take the case of the 'Kent' at the Falklands. The 'Kent' is an old vessel. She was launched 13 years ago, and has been running ever since. The 'Kent' was designed to go $23\frac{1}{2}$ knots. The 'Kent' had to catch a ship which went considerably over $24\frac{1}{2}$ knots. They put a pressure and a strain on the engines much greater than is allowed in time of peace, and they drove the 'Kent' 25 knots and caught the 'Nurnberg' and sank her. It is my duty in this house to speak for the navy, and the truth is that it is sound as a bell all through. (Cheers.) I do not care where or how it may be tested; it will be found good and fit, and keen and honest. It [illegible] ling workmen and faithful workmanship, and careful clerks and accountants, and skilful engineers, and pains-taking officers and hardy tars."

Making Figures Lie.

[illegible] travagantly skeptical turn of mind, the axiom that figures cannot lie is received as an infallible truth worthy to rank with demonstrated mathematical facts. Yet it is amazing to reflect how frequently the veracious figures that record the results of accurate mechanical experiments are made to parallel the audacity of Munchausen literature. In all departments of mechanical work, devices are constantly being offered for application that are guaranteed to save all the way from five to fifty per cent., and when a test has been made the inventor generally demonstrates that his claims have been proved correct.

Railways are regarded as a particularly promising field for the operation of parties owning patented appliances designed to save money when savings seems impossible. There is scarcely a railway in the country, where a man cannot succeed in proving that a saving of ten per cent., or more, will follow the adoption of any device he may have for sale, if he is permitted to go about the business in his own way. This is how so many trials have been made of patent valves, grate bars, spark arresters, smoke consumers and other attachments of locomotives, and how so little real saving has resulted from the use of appliances that promised enormous savings.

An inventor or his agent goes to the head of the mechanical department and dilates upon the results of a newly patented device. Mechanical officials are not generally zealous to adopt patented appliances, and the agent finds the atmosphere of the mechanical offices chilly, so he goes to a friend who has influence with the management and receives an order to have the device tried entirely on its merits. It is placed upon an engine that has been pulling a certain train regularly, and where there are proper facilities for showing the fuel or oil used before or after the new invention was applied. Before the device was put on their engine, the engineer and fireman worked away in an apathetic manner, not wasteful nor careful about how the engine was worked. But when the new device was [illegible] behavior, the eyes of officials and others were upon them, with the result that the [illegible] and there was no difficulty in showing a [illegible] the new invention received the credit for [illegible]

On one railway in the United States noted for keeping a careful record of [illegible] try many new devices, it is admitted that [illegible] shown. It takes little difference what the [illegible] a smoke consumer, next month an improved lubricator; both will have about the same effect upon the coal piles. But the officers of the road realize how the apparent saving is produced and what the result would be were the invention adopted for permanent use.

All railways are not situated so that the officials responsible for checking wasteful practices can identify causes that need to be remedied. Neither are they to blame for adopting appliances that seemed to possess merit until every day experience proved them worthless. Every day experience gives the proper test. There is of course something radically wrong in methods of engine operating that will make a worthless device appear to have merit only while under a test. If an engineman can save ten per cent. of fuel or other supplies under inducement to work economically, he ought to keep up the efforts that produce the best results.

Fuel accounts are kept so loosely on many roads, that actually no proper check is placed upon men who are habitually wasting fuel. When no check exists upon the evildoer, the man who labors to make a good record receives no credit for his superior performance. Consequently, the tendency is to make all enginemen indifferent to desire for economy and to desire merely to get over the road comfortably. It is human nature to feel that way, and enginemen are really not so much to blame as the officials who permit chaotic methods that have a demoralizing tendency.

Superstitions of Trainmen.

Men engaged in hazardous occupations are nearly always superstitious. The causes for this are not difficult to find. When they meet with so-called bad luck, any preceding incident is apt to be regarded as an omen, and men who work with their lives in their hands have their perceptions quickened by such supposed omens. Primitive people are nearly all superstitious, a condition which is gradu- [illegible] superstitions. When railways were first opened in Scotland north of the Firth of Tay, many young Highlanders found employment as trainmen, and their superstitious habits were sometimes embarrassing. One day, in the writer's experience, an engine driver failed to take out a passenger train as ordered, giving the excuse that he was taken suddenly ill. It turned out that a jackdaw crossed his path on his way to the station and he regarded that as evil omen that could not be safely ignored. On recovering after a day's rest, his wife told a neighbor the real cause of Donald's illness, and he was given two weeks holidays to study the habits of jackdaws. Several similar cases brought punishment which gradually stopped the men from yielding to their superstitions.

But superstitions were not entirely confined to foreign enginemen. The writer had a fireman who cherished much fondness for an old horseshoe that he had picked up on the highway, nailed it up on the cab of the engine, and considered it highly efficient in preventing accidents. It was a rough article, far from being ornamental in appearance, so it struck Tom, the fireman, that a little grinding would polish up the shoe and improve its looks. One day he took it to the machine shop and proceeded to polish it. The work was not finished when starting time came, so he left it behind. We had not got away more than five miles, when through a mistake of orders we met another train on the same track. We met on a curve and there was brisk scrambling among the trainmen to get as far as possible into the country before the crash happened. The fireman displayed extraordinary agility, but his flight was arrested by the clutches of a barbed wire fence. As he vainly struggled to free his unmentionables from the entanglement he was heard to shout, "If I had left that blamed horseshoe alone, this would not have happened."

Mysteries of Mercury.

In these days of experiment and the making of scientific lists, most mechanical men have more or less to do with metal mercury, and to most men coming in contact with it, the substance is a subject of earnest study. Mercury is an elementary substance known as Hg.

It might be supposed that the nature of the metal would prevent it from being an object of adulteration, yet that is not the case. Mercury being an expensive substance, it is frequently adulterated with tin, lead and other cheap metals that can be readily dissolved in mercury without greatly affecting its fluidity. Manipulations of this character spoils mercury for experimental purposes. The presence of foreign matter in mercury can readily be detected by putting a drop of the metal on a plate of glass and rolling it over the surface. Pure mercury leaves no trace, but rolls in spherical globules, while adulterated mercury forms elongated tears covered with a gray pellicle which adheres to the surface.

[illegible] amalgams with other metals at ordinary temperature is said to have led to the testing in the transformation of metals, which did so much to advance the science of chemistry. The Chinese were familiar with mercury several centuries before the Christian era, and they had a belief that where cinnabar, the ore of mercury, was found on the surface, gold would be found beneath.

European chemists, those belonging to the Arabian school, derived their ideas on the transmutation of metals into gold, and belief in the immunity from death by use of the philosopher's stone from the Chinese chemists who were manipulating mercury.

First Description of a Freight Car.

In Desaguliers' Course of Experimental Philosophy, published in London, in 1734, there is a description of a railway car used on an English railway to carry stone from a quarry. This is undoubtedly the earliest illustrated description of a railway car, and the track is called a "wagon way." It was later called a tramway.

The wagons are said to consist of a strong floor of oaken planks three and a half feet wide and about 13 feet long. At right angles under the beams are two strong timbers well strengthened with iron plate. At the ends of these are two semi-circular pieces of brass which serve as collars for the axle-trees of the wheels, which, being well greased turn with little friction.

The wheels are of cast iron with flanges that go inside the rails. The wheels are attached to the ends of the axle-trees that are about three inches diameter. Each wagon was said to cost thirty pounds sterling, and was capable of carrying four tons. The description applies to a modern British freight wagon and displays few lines of progress.

The Mud Hen Locomotive.

Years ago when financiers were not very keen to spend money building railroads into sparsely inhabited regions, a gentleman in Iowa, well known as a successful agriculturist and extensive land owner, became possessed of the desire to figure as a railroad magnate. He had been a granger agitator and made the statement so often that railroads could be built at one-tenth the cost of existing lines that he came to believe it. So this agriculturist proceeded to demonstrate his ability as a railroad builder and he succeeded in getting a few miles of track in running order. All the material used was old second-hand stuff that established roads could no longer use, and he succeeded in building a cheap road so far as it went. A connecting road had an old locomotive which was popularly known as the "Mud Hen," owing to her propensity for the ditch. This locomotive the agriculturist bought to operate his road. Shortly after the purchase had been made, a friend who had some knowledge of machinery, and did not approve of the Mud Hen purchase ventured to expostulate with the new owner. "Not a [illegible] say?" he replied; "you must be mistaken. The Rock Island Railroad would never have kept a locomotive twenty-five years if she had not been a good one."

A Barber Who Turned Engineer.

During a recent journey over a trunk line the train made a prolonged stop between stations, owing as the trainmen explained the engine being disabled. After waiting about 40 minutes the writer went forward to see what was the matter and found that the engineer was wrestling with a slipped eccentric. The man knew how to reset the eccentric, but it had got jammed on the key so that moving was very difficult.

The incident reminded us of an amusing case where ignorance concerning eccentrics detected in time an incompetent man who obtained a position as locomotive engineer through the use of forged letters. The man had been hired during a busy time on the strength of apparently good recommendations. He made a few trips to learn the road and was then sent out on a Grant engine. After getting out twenty-five miles, he telegraphed back that his engine had slipped an eccentric and wanted to know what to do. The answer given was, "Set the eccentric and go on with your train." Presently another dispatch was received at headquarters saying that eccentrics on both sides were slipped and that the fire had been dumped. The order was then sent to have the engine hauled home. On examination it was found that the engine had a broken valve yoke, and that in mistaking this for a slipped eccentric the man in charge had got the eccentrics all over the driving axle.

It was afterward found that the man had not even been a fireman, but only a head brakeman, where he learned to handle an engine after a fashion and superlative cheek made him think that he could bloom out as an engineer. He opened a barber's shop afterward in the town and was a smooth shaver. He used afterward to joke about his experience as an engineer.

Largest Railway Tunnel in America.

The Rogers Pass five-mile tunnel under the Selkirk Range, now under construction on the Canadian Pacific route, will be the longest railway tunnel on the American continent, the longest at present being the 4¾-mile Hoosac tunnel on the New York Central. The $10,000,000 Rogers Pass tunnel will shorten the route four miles and materially reduce the grade. Since the completion of the Canadian Pacific in 1886, the first transcontinental railway built across continent in Canada, the company has spent millions of dollars in protecting and renewing its tracks, on extra locomotives used to haul trains up heavy grades, and in coping with snowfalls and other physical handicaps which keep a large force of men and a large amount of expensive equipment busy practically all the year. At Rogers Pass, close to the summit of the Selkirks, the company now maintains large engine sheds, shops, snow-plows, and outfits ready for service on both sides of the range. The tunnel, which is 29 feet wide and 23 feet high, follows a straight line under Mount Macdonald, emerging in the Beaver Valley at a point about 1,000 feet below the present line. The eastern entrance is directly below Hermit, a station just east of Rogers Pass. The highest point reached in the tunnel is 3,795 feet above sea level and 4,065 feet below the summit of Macdonald Peak. The passage through the mountains will have a grade of 1 per cent. up to the interior summit.

The Energy of Projectiles.

The German infantry rifle M-98 takes a powder charge of 3.2 grammes, the explosion of which produces 2,762 gramme-calories of heat, equivalent to 1,170 meter-kilogrammes (8,463 foot-pounds). Nearly one-third of this energy is consumed in giving the bullet its initial velocity of 820 meters (2,690 feet) per second, and nearly one-quarter is used in heating the rifle barrel. The rest of the energy, about 45 per cent., is represented by the hot gases and the report. The bullet traverses the barrel in about 1/2000 second, during which period the pressure inside the barrel is 3,500 atmospheres.

The projectile of a 16-inch gun possesses a kinetic energy of 300 million foot-pounds, equal to that acquired by a granite block 33 feet square and 17 feet thick in falling 100 feet. The projectile of the Krupp 30.5 centimeter (12.2-inch) naval gun weighs 445 kilogrammes (980 pounds), and has a muzzle velocity of 820 meters (2,690 feet) per second.

Its range is about 20 kilometers (12.4 miles), and it travels this distance in about 95 seconds.

Increased Rates.

It is gratifying to observe that the proposed increased rates on scrap steel and iron from the Mississippi valley and certain gulf ports to St. Louis, Ohio river crossings, and points beyond were approved by the Interstate Commerce Commission, in a decision, May 14. The rates to St. Louis will be increased, and on the increased rates to that city differentials will be established, affecting the other principal markets. In a decision on May 17, the commission found present class rates of the Chicago, Milwaukee & St. Paul and other railroads between Freeport and Rockford, Ill., and points east of the Illinois-Indiana state line unduly discriminatory, compared with the rates from other cities in the same territory, such as Chicago and Peoria. The rates from Rockford also were found unreasonable. An additional charge of 5 [illegible] Chicago & Northwestern and other railroads serving mines in the Michigan peninsula was held justified in another decision.

Operation of the Work of the Boiler Inspection Service

Statistics and Suggestions Presented by Mr. McManamy, Chief Inspector

[illegible] Mr. Frank McManamy, chief boiler inspector, under the Interstate Commerce [illegible]

[illegible] motive Boiler Inspection service during the three years and eight months since the law became effective shows results for which we have not one single word of apology to offer. The following table shows in concrete form the inspection work performed each year since the passage of the law; and the decrease in the percentage of locomotives reported defective indicates in a measure the im[illegible]

	1914.	1913.	1912.
Number of locomotives inspected	92,716	90,346	72,234
Number found de[illegible]	[illegible]	[illegible]	48,768
Percentage found de[illegible]	[illegible]	[illegible]	65.7
Number ordered out of service	3,365	4,676	3,377

It does not, however, fully show the improved conditions resulting from the operation of the law, because, as pointed out in our 1913 report, attention was first concentrated on the more serious defects, so that the number of fatalities might be reduced; therefore, the improvement is more accurately indicated by the reduc[illegible] as shown by the following table:

	1914.	1913	1912.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible] year, per cent	32.3	4.2	
Decrease from 1912, per [illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible] year, per cent	32.6	9.3	

The data shown above is taken from the [illegible] year, that is from July 1, 1914, to January 1, 1915, in comparison with the corresponding period in the preceding year [illegible]

During the period ended January 1, [illegible] which resulted in injury, with 15 killed [illegible] riod ended January 1, 1915, there was a total of 253 accidents which resulted in injury, with 6 killed and 271 injured there[illegible] number of accidents, 60 per cent. in the number of killed, and 30 per cent. in the number injured by the failure of locomotive boilers and their appurtenances.

Going back further and making a comparison with the corresponding period for 1912, we find that during the six months period ended January 1, 1913, there were 470 accidents which resulted in injury, with 24 killed and 512 injured thereby. In other words, the number killed by failure of locomotive boilers and their appurtenances during the first half of our fiscal year which began on July 1, 1912, was 12[illegible] per cent greater than for the

FRANK McMANAMY.

corresponding periods in the two follow[illegible] annum to less than one-half that number, with a corresponding decrease in the number of accidents.

Another matter that has not always re[illegible] the location of the bottom water glass fitting. The opening of the boiler for this fitting should always be above the highest [illegible] have been located without much regard [illegible] proper height of the lowest reading of the glass being obtained by the use of nipples of various lengths. When this opening to the boiler is made below the highest point of the crown sheet, if the top water glass cock is closed or the opening restricted, water will show in the glass when there is none on the crown, and we have records which show that this has been the cause of more than one crown sheet failure; therefore, I desire to urge the importance not only of having the lowest reading of the glass the proper distance above the crown sheet, but also of having the fittings so applied that the glass can not under any circumstances show water when the crown is bare, and this means that the fitting should be so designed and located that the proper reading of the glass can be obtained and the opening to the boiler kept above the crown sheet.

Angus Sinclair's Suggestions Approved at a Meeting of the C., H. & D. R. R.

At the regular monthly fuel meeting of the railway men of the Cincinnati, Hamilton & Dayton Railway, held at Ivorydale, Ohio, on May 11, Mr. M. P. Hoban, road foreman of engines presiding, there was a large attendance, and its chairman read for the edification of the members Dr. Angus Sinclair's article on Smokeless Firing, which appeared in the April issue of RAILWAY AND LOCOMOTIVE ENGINEERING. A number of members warmly agreed that the system of firing by applying two or three scoops at a time and holding the fire doors on the first latch for a few seconds after each application was the best method of smoke prevention. Mr. H. W. Brown, road foreman of engines, presented interesting records showing what could be accomplished when the engineer and fireman worked together along the lines suggested in Dr. Sinclair's paper. Mr. W. I. Johnson, master mechanic, testified his approval and urged the necessity of fuel economy and smoke prevention, and assured the members of his desire to help them in any way to obtain the best results. Mr. Funk, railway smoke inspector, also testified his approval of the methods of abating the smoke nuisance. Mr. W. H. Roberts, engineer, reported meeting Mr. Heath, City Smoke Inspector, Cincinnati, who also strongly approved Dr. Sinclair's suggestions and gratifying results had already been shown, especially in locomotives arriving and leaving Cincinnati, and which has met the approval of the mayor and city council.

Air Brake Department

Twenty-Second Annual Convention of the American Air Brake Association

Important Papers Discussed, Reports, and Election of Officers

The first paper on technical subjects presented before the 22nd annual convention at the Hotel Sherman, Chicago, Ill., May 4, was entitled, "Accumulation of Moisture and Its Elimination from Trains and Yard Testing Plants," and read by Mr. Mark Purcell of the Northern Pacific.

The general sense of the paper is expressed in the opening paragraphs wherein it is stated that the benefits derived from using compressed air in storage yards for brake tests and inspection, as well as for many other purposes, are generally recognized by air brake men and that practically all passenger car yards of any importance are now equipped with such compressor plants, but the great difficulty encountered is in obtaining what is termed "dry air," that is, compressed air from which all the possible percentage of moisture has not been collected

Our readers will understand that water in yard test plant pipes means that it will be carried into the brake system, destroying lubrication and in cold weather, freezing of apparatus, resulting in troubles that are very well known.

Mr. Purcell explains how the elimination of water from test plants can be accomplished and how it is being done in the Mott Haven yard of the New York Central by what is known as a "cooling plant" which is described in detail and illustrated with photographic views, showing what first appears to be quite an elaborate installation; but it has been found from experiments that at least three running feet of ¾ inch pipe is required for every cubic foot of free air to be cooled, hence the cooling plant arrangement conforms to the air compressor capacity employed.

The information given in detail as to correct piping, drainage, etc., is of exceptional value to the installation and maintenance of yard test plants in any climate.

During the discussion of the paper the matter of moisture entering the brake system from the locomotive was also considered and some additional information on air pump and main reservoir piping was obtained, Mr. Remfry taking the stand that there should be no shortening of pump discharge pipes to prevent freezing in cold weather where, if freezing does occur it will be at points about the first main reservoir instead of in the brake pipe so that in this event it may be detected and remedied without incurring undue risk, whereas if the freezing occurs in the brake pipe an accident may result.

Mr. Dow cited instances in which water entered the brake system from the use of steam in the locomotive reversing gear when these are either steam or compressed air operated devices, which is generally the result of carelessness, as cut out valves and check valves are provided with such arrangements to preclude such occurrences if the valves are in good condition and correctly used.

Further suggestions as to changes in standard practices of air pump and main reservoir piping to conform to various climatic conditions were considered and it was decided to continue the investigations as to correct locomotive piping arrangement.

The second paper was entitled, "What Shall We Do to Improve the Operation of the Present Standard Pneumatic Signal Device," and presented by Mr. L. N. Armstrong.

Briefly, the limitations of the standard signal system is dwelt upon and the advantages of the use of the electro-pneumatic system are mentioned, but while there are conditions in modern service where the standard system is not absolutely reliable even if in a reasonable state of efficiency the chief difficulty experienced in securing correct operation appears to be due to a lack of sufficient attention to the signal apparatus and the development of a considerable amount of leakage on long trains, this tending to give false signals and destroy the confidence of the crew in the signal system.

The location of piping and hose couplings is shown to be of vital importance to the elimination of unnecessary leakage and the most approved methods are outlined.

It is also pointed out that in operating the signal whistle on unusually long passenger trains it is necessary to allow approximately five seconds' time to elapse between pulls of the cord and that the car discharge valve should be pulled wide open and allowed to close promptly.

The importance of correct fit of diaphragm stem in signal valve bushing and the maintenance of the 1/32 projection at the end of the stem are forcibly touched upon and rightfully so, as many repairmen have become imbued with the idea that it is good practice to remove some of the end of the stem to permit the diaphragm stem to extend further into the bushing thus obtaining a heavier bearing above the annular groove, when attempts are made to repair signal valves in railroad shops.

This is obviously a mistaken idea and a very bad practice as the function of the projection at the end of the diaphragm stem is to prevent a blow from the whistle at such times as the stem may be raised less than 1/32 of an inch due to slight leakage or jarring of the engine.

As an idea of the accuracy of fit that must be maintained, the signal valve stem must be .0005 inch less in outside diameter than the inside diameter of the bushing and if the difference is less than .0002 inch too long a blast or undesired blasts of the whistle will occur, while if the stem is .0015 inch smaller than the bushing it is inclined to show up too loose in a test.

Quite a number of experiments were made to determine what signal system pressure would give the best results and it was found to be 60 pounds, but no change from the present standard has been recommended.

A number of signal pipe recording charts show that with the E. T. brake, 45 pounds adjustment of the feed valve gives 42 pounds in the signal pipe, the resistance of the check valve spring being about three pounds.

The readers will understand that the only approved test for signal values is on a rack, the piping of which approximates that of a 12 car train.

The third paper was, "Difficulties the Railroad Companies Encounter in Endeavoring to Run 100 Per Cent. Operative Brakes in Freight Train Service." read by Mr. G. H. Wood.

The authors presented the view that an operative brake is one in which the piston moves out of the brake cylinder far enough to close the leakage groove and not more than 10 inches, under at least a 70 pound brake pipe pressure and remains so until the usual inspection is made, that it releases properly under the usual methods resorted to and that the foundation brake gear be connected throughout to bring the shoes to the [illegible]

One hundred per cent. operative may be taken to mean that all brakes operate from the locomotive in this manner which of course becomes more difficult as the length of the train or number of cars is increased.

The paper cites as an example, a train of 20 cars starting from a terminal with all brakes operative and at another point the train may be increased to 40 cars and it may be found that some of the first 20 cars will not be operative under the more severe conditions, other cars may be added or mountain grades may be approached [illegible]

[illegible] that will not stand the retaining valve test, thus inoperative brakes are many times permitted to avoid delay to important shipments.

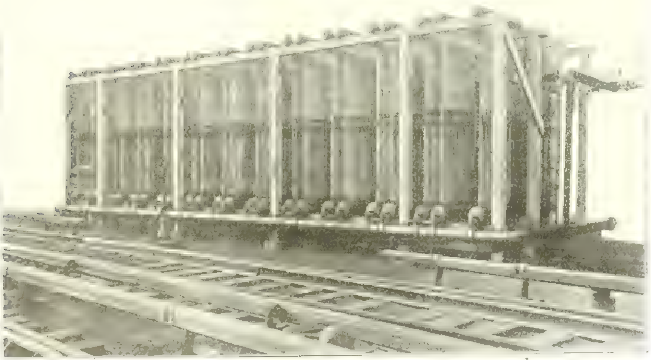
It is pointed out that no concrete instructions as to 100 per cent. operative brakes en route can be followed by any one road if all other roads offering cars in interchange do not insist upon the same [illegible]

The paper outlines repair work methods and test facilities necessary to maintain car brakes in a manner that will permit of any marked advance in the desired direction and among the numerous difficulties encountered are air brake repairmen who have missed their calling and must be transferred or dismissed or if a man has developed to a state of efficiency he frequently finds more desirable employment necessitating the use [illegible]

brake cut out and on testing nothing is found wrong except the retainer being turned up and others with nothing but a leak at the triple valve union requiring [illegible]

"All of these things work against the percentage of operative brakes and are irregularities against which a crusade would [illegible] every railroad concerned."

Irregularities and disorders in the locomotive equipment that contribute to conditions that frequently lead to cutting out car brakes are also brought to notice, especially the condition of the brake pipe feed [illegible] tail the reasons why the 100 per cent. operation of brakes is so vitally necessary to an improvement in train handling and a further freedom from damage to trains as those are well known from past papers on the subject of "Break-in-Two of Trains."



[illegible]

tensive investigation the committee has ob-[illegible]

[illegible] out in trains on being tested are found to be in first-class condition and in a great many cases are the best brakes in the train. We find trainmen cutting out brakes that do not release as soon as others in the train, not waiting until the brake pipe pressure has raised high [illegible] best packing leathers. We find men who have a hobby of keeping the caboose brake cut out, afraid of sliding wheels, and others who will cut out cars and bleed them in order to make a switch quickly.

"We find engine men who will cut out tender brakes because the triple valve will not release promptly or because they are afraid of hangers breaking, and others who will insist on having the piston travel let out beyond the limits on car, claiming [illegible] all engines. Cars are found with the

During the discussion of this paper the [illegible] pressed air for operating 100 per cent. of the brakes was constantly kept before the members as conditions have now changed to such an extent that two 9½-inch versus one 11-inch compressor can not be considered any more than two 11-inch versus one 10½-cc because it is generally conceded that long freight trains on heavy grades require two units of cross compound or duplex compressors to produce the necessary volume of free air at the required rate.

It may be stated in connection with the paper that Mr. Turner took his usual exact view of the situation claiming that there is no such thing as 100 percentage of brakes in a train, that the train is one brake and must be considered as such to improve the efficiency, and at that time gave some very valuable advice, especially to the younger members of the association.

The closing of the discussion of the paper was followed by the annual revision of the association's recommended practice.

The fourth paper was, "Adequate Hand Brakes for Heavy Passenger Equipment Cars," by Mr. J. P. Kelley. Attention is called to the difficulty in providing a hand brake for such cars that will be efficient and still be arranged so that a man of average muscular strength may operate it. From the many number of heavy cars damaged in shifting through an inefficient hand brake, or the use of powerful release springs makes the immediate design of an efficient brake necessary.

The paper was discussed and it was decided to carry it over to the next meeting for the purpose of obtaining some additional information upon which to base a design and rearrange foundation gear and accessories.

The paper on "M. C. B. Air Hose Specifications" was postponed until such time as the tests now being made by the M. C. B. Association are completed.

Paper on "Need of Efficient Cleaning and Repairing of Freight Brakes" by Messrs. Purcell, Slattery and Von Bergen was also carried over to the next convention because the information collected on the subject had been of such a nature that there was not sufficient time to tabulate it to the entire satisfaction of the committee.

After certain revisions in the constitution and by-laws the election of officers was proceeded with, the result being:

President, J. T. Slattery, D. & R. G. R. R.; first vice-president, T. W. Dow, Erie R. R.; second vice-president, C. H. Weaver, L. S. & M. S. R. R.; third vice-president, C. W. Martin, Pennsylvania R. R.; secretary, F. M. Nellis; treasurer, Otto Best; executive members, J. F. Barry, N. Y., O. & W. R. R.; T. F. Lyons, L. S. & M. S. R. R.; Mark Purcell, Northern Pacific R. R.; L. P. Streeter, Illinois Central R. R.; G. H. Wood, A. T. & S. F. R. R.

[illegible]

Convention assembled at 9:30 a. m. with the president, Mr. L. H. Albers, in the chair.

Address of welcome was delivered by Mr. Robert J. Quayle, general superintendent motive power and rolling stock, [illegible]

The president's address touched upon that vital subject, economy, combined with safety and efficiency and in this connection Mr. Albers requested a committee to confer with the M. C. B. Association with a view of considering some recent air brake tests and from them the advisability of lengthening the time between cleaning and lubricating passenger car brakes.

The continuous sessions of business depression and railroad legislation has finally made its impression on the Air Brake Association, a considerable loss in membership and falling off in the sale of books

has reduced a balance of several thousand dollars to $427.91.

A handsome loving cup was presented to Mr. S. J. Kidder, of the Westinghouse Air Brake Company, in recognition of his many years of service to the Air Brake Association. Our readers will know Mr. Kidder from his articles in RAILWAY AND LOCOMOTIVE ENGINEERING. He is a practical graduate from the old school who has kept pace with the new order.

The manufacturers' exploitation meeting was an agreeable surprise in that the speakers were expected to solely advertise their wares, but instead they were inclined to touch upon mechanical problems and changes in operating conditions which necessitate the use of apparatus such as they offer and in no instance did any of their remarks reflect upon their competitors.

The convention was addressed by a former member, Mr. E. H. De Groot, superintendent of transportation, C. & E. I. R. R. who eulogized the work of the Air Brake Association and humorously related his experiences at the first convention how men were pointed out to him whom he read of in the pages of LOCOMOTIVE ENGINEERING, which is at the present time RAILWAY AND LOCOMOTIVE ENGINEERING.

Mr. M. H. Haig, mechanical engineer of the Santa Fe system, also addressed the convention with some well chosen remarks taken from an engineering point of view.

The Royal Society of Arts, London, England, has seen fit to confer a distinctive honor upon one of our members, Mr. W. V. Turner, who has been selected as a fellow member.

From an air brake point of view it is decidedly encouraging to observe master mechanics, mechanical engineers, division superintendents and superintendents of motive power and in some instances superintendents of transportation, taking part in the discussions on the floor. It indicates that between federal regulations and decreases in revenue, the air brake is becoming a very live proposition.

For some years past Mr. W. V. Turner has delivered lectures which were one of the features of the meetings. This year representatives of the New York and Pittsburgh air brake companies were invited to participate and bring their apparatus to the attention of the members.

Mr. N. A. Campbell, of the New York Air Brake Company, very briefly described their type P. S. electro pneumatic brake for steam road service, and Mr. J. R. Snyder, of the Pittsburgh Air Brake Company described their electro pneumatic brake systems for steam road service and their "no-kicker" triple valve.

Mr. Turner, of the Westinghouse Company, made but a few remarks concerning a braking problem on the New York subway, and referred to a new type of electro-pneumatic brake which is self-adjusting as to braking force and weight of cars and controlled and automatically varied by the passengers entering and leaving the cars, the brake being designed to utilize practically the full value of rail adhesion in producing a stop.

Any brake cylinder pressure from 0 to 140 may be obtained, using but 70 pounds brake pipe pressure, and this improvement in connection with the solution of another engineering problem will again double the carrying capacity of the subway system, the whole saving of time being made up in keying up, accelerating and retarding forces in a manner hitherto unknown. The descriptions of these new brake systems will be found in future issues of RAILWAY AND LOCOMOTIVE ENGINEERING.

L. H. ALBERS,
President, Air Brake Association, [illegible]

The convention adjourned to meet in 1916, at Atlanta, Ga.

Crane Locomotives in Use in India.

Crane locomotives in use in India are arranged to use oil as fuel. A firebox fitted to burn oil can be modified so as to burn coal, if necessary. The oil is carried in a rectangular tank between the dome and the safety valve and spraying nozzles for injecting the oil into the locomotive furnace are fitted at the fire doors. A small fire is kindled with wool or coal; when it is fairly under way the oil spray is started and continues the burning. The supply of oil can be regulated with much greater nicety than the supply of the more solid fuels, such as coal or wood, and when the locomotive is not at work [illegible] can be obtained, that is the amount sufficient to keep the temperature of the firebox up to the point at which it will readily ignite oil when sprayed in. There is not any danger of fire from hot cinders when a locomotive of this type is used, and the oil supply [illegible] discharge is both sparkless and smokeless [illegible]

Indian tea estates have the following details: The cylinders are four in number, 7½ inches diameter x 12 in. stroke; the gauge is 2 ft., and although the total wheel base is 19 ft., the rigid wheel base, owing to the special construction adopted, is no greater than 5 ft. The engines are designed to run on a rail of 20 lbs. per yard and will readily take curves of 66 ft. radius. The weight of the locomotive in working order is 19 tons; the working pressure is 160 lbs. per square inch. Locomotives made of this type have each two bogies; each carries a pair of cylinders equipped with all the necessary valve gear, etc., and is in fact, an independent engine. The bogies are free to swing within the limits determined by the design and the cylinders; four in number altogether are supplied with steam by a common boiler supported on the frame to which the bogies are pivoted. The result is an extremely flexible engine of great hauling power, the rigid wheel base of which is short, enabling it to take the sharpest curves with great freedom. The weight of the engine is spread over a considerable length, enabling rails, which in the ordinary way are suitable only for very light engines to carry these engines of exceedingly high hauling power. Bridges of somewhat lighter than normal construction may serve on account of the spread of the engine. A special feature of the bogies is that each of them is fitted with special axle boxes on one of the axles, thus allowing side play, with the body of the engine conforming freely to the very sharp curves. Ball joints are fitted to the side rods. The valve gear is of the Walschaert type and placed on the outside, so that every part is readily accessible.

At its 13th annual meeting last month the Canadian Railway Club elected the following officers for the ensuing year: President, Mr. L. C. Ord, works manager, Angus shops; first vice-president, Mr. R. M. Hannaford; second vice-president, Mr. George Smart; executive committee, Messrs. T. C. Hudson, E. E. Lloyd, J. Hendry, C. Manning, E. B. Tilt and Prof. H. O. Keay; audit committee, Messrs. W. S. Atwood, W. H. Winterrowd and F. A. Purdy; secretary, Mr. James Powell; treasurer, Mr. W. H [illegible]

The Union Signal Construction Company, Pittsburgh, Pa., has been incorporated at Dover, Del., with a capital stock [illegible]

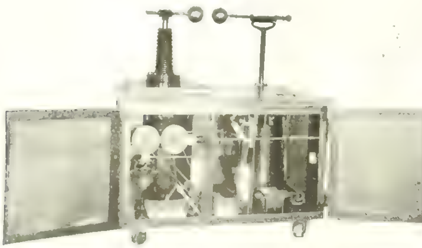
[illegible] in all kinds of railroad supplies, including signal apparatus. Mr. W. D. [illegible], Pittsburgh, Pa.; Mr. T. W. [illegible] and Mr. T. S. Grubbs, [illegible]

Electrical Department

General Electric Company's New High Frequency Oscillator
Appliance for Testing Porcelain, Insulators and Bushings

One of the recent developments of the laboratories of the General Electric Company, and now commercially available, is the 125,000-volt, portable, high frequency oscillator, an outfit designed for the purpose of testing porcelain, high tension [illegible] high frequency, high potential current. This equipment is built for operation on [illegible] and may be connected for 110 or 220 volts. It requires about 1½ kv-a. at 25 cycles, 2 kv-a. at 40 cycles and 2½ kv-a. at 60 cycles, and will deliver current having frequencies of approximately 300,000 cycles at voltages up to about 165,000 volts.

In addition to the 125,000-volt set, to which this description applies, a 250,000-volt set for testing large porcelain parts can be furnished. A 500,000-volt set is under construction. A small 100,000-volt set designed to test a single insulator and [illegible] ability will shortly be available. Although this last set does not have all the refinements of the larger sets, it should be very well suited for testing insulators on a [illegible] new insulators ready to be placed in service.



[illegible] HIGH [illegible]

The usual high potential test of ap- [illegible] at 60 cycles for one minute. It can be said, however, that insulators successfully passing this test never fail in practice due to 60 cycle potential; but they are damaged electrically by lighting, by heavy surges from switching, by heavy surges from arcing grounds and similar causes, where high frequency is always present and there is a menacing rise in potential. It would seem, therefore, in order to safeguard against all such natural hazards [illegible] against failures of insulators, that they should undergo the high frequency test.

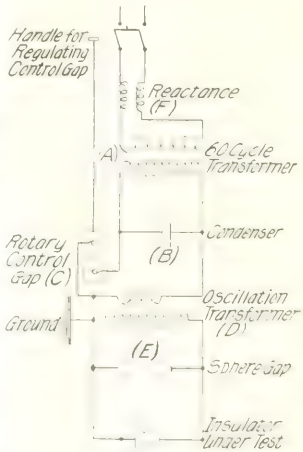
Sixty cycle voltage has very little corona effect on most insulators. The discharge is accompanied by a single spark, which either punctures the porcelain or creeps around the skirt surfaces. The probable tripping of the circuit breaker, as a result of this sudden spark, necessitates bringing up the potential again until the second discharge takes place. This test, consequently, leaves unstressed many portions of the porcelain that would otherwise be stressed and affected by transmission line surges.

In contradistinction, when high frequency is applied to an insulator, the whole insulator is bathed in a visible and audible corona, which clings more closely to the surface and searches more thoroughly for flaws, and can be extended almost to the edge of the skirts before a spark discharge takes place. This spark then extinguishes itself and relieves the stress in that particular location, whereupon a new spark is formed elsewhere on the insulator surface. One hundred and twenty sparks per second can be thus produced, which is equivalent to 120 separate [illegible] with a 60 cycle [illegible]

Experimentation has revealed some interesting and significant information on [illegible] porcelain parts of different types tested by each method. [illegible] of 8 per cent. of failures, as the result of the application of high frequency after the insulators had successfully withstood the 60 cycle test, indicating that high frequency furnishes a more exacting test.

High frequency tests at manufacturers' plants, aside from eliminating insulators unfit for all natural hazards of service, should prove valuable in determining the uniformity of vitrification, and the proper proportion of thickness to length in different parts of the porcelain. Faulty in- [illegible] facture, such as foreign matter in the wet porcelain, which may burn out during the firing process and leave air ducts. Unequal contractions in drying may result from lack of uniformity and leave imperceptible cracks. Underfiring leaves porcelain in a porous condition and weak in dielectric strength. Improper proportioning may result in over-stressing more perfect parts, thereby resulting in puncture before the arc can move around the skirts. Absolute uniformity in porcelain is, naturally, practically unobtainable; and when subjected to extreme strains, the weakest parts naturally fail first, although such parts may be strong enough for ordinary operating conditions.

It has been contended that the high frequency test might be dangerous to porcelain. The object of this test is to be dangerous to electrically imperfect porcelain. Experience has proved that it is not harmful to good porcelain, providing the insulators are properly proportioned and constructed, and the electric strain is not carried unreasonably too close to maximum limits. The duration and intensity of tests should be governed by the



[illegible]

stresses insulators are expected to stand in service. Insulators that fail under such tests would fail under similar stresses in service.

The high frequency oscillator is designed for testing porcelain insulators only. It is best adapted to testing at the factory, laboratory or at some point on a transmission system where insulators are delivered or tested. The number of insulators that can be tested in multiple depends on the type of insulator. Five suspension type insulators can be tested in multiple at a test voltage of 80,000, and frequency of 300,000 cycles per second

Where transportation conditions permit, the oscillator can also be used to test suspension insulators in place on the line and pick out deefctive ones, providing the spark potential of the individual disc is not greater than the voltage rating of the oscillator (125,000 volts). Under the same conditions the oscillator can be used to test any pin insulator, providing it is mounted on a dry wooden crossarm, or is mounted on a metal crossarm that is carried on a dry wooden pole and is not connected to a ground wire.

The essential elements of the high frequency oscillator are: a step-up transformer, 13,000—110/220 volts; a condenser placed across the terminals of the high voltage coils of this transformer; an adjustable control gap; an oscillation transformer, oil immersed, with no iron core, consisting of a few turns on the primary and many turns on the secondary; a properly proportioned sphere gap; a suitable reactance to protect the step-up transformer against the damaging effect of short circuit when a spark takes place at the control gap.

The oscillating current transformer consists of two concentric windings arranged vertically in a stoneware jar and immersed in oil. They are connected together at one end and grounded, the outer coil consisting of the few turns of copper strip wound on a form of treated wood. The ends of the coil are brought out through the stoneware jar under the oil and are connected to the condenser and spark gap. The condenser, as stated, is charged by the 13,000 volt supply transformer.

The voltage is controlled by gradually opening the control gap, one electrode being grounded and connected to a rod extending through the side of the case, which permits manipulation while the arc is playing across the gap. The high frequency high potential across the sphere gap is read directly in volts off a graduated scale provided with the outfit. The fuses and disconnecting switches are mounted inside the frame. The main switch being connected by a rod to a handle just above the control gap handle. These two handles represent the entire control of the apparatus, the element of the duration of test desired being readily governed by the switch handle.

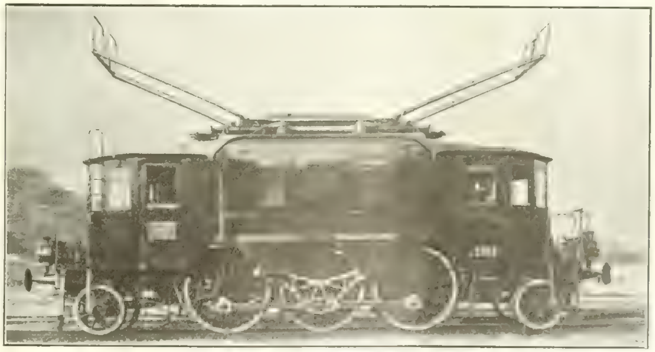
The electrical operation is interesting. Current at 110 or 220 volts is received at the low tension side of the step-up supply transformer. The voltage across the high tension side is then limited by setting the control gap, which is in series with the high tension circuit of this transformer. As the voltage across the control gap increases, the condenser becomes charged; and when there is sufficient voltage to spark across the control gap, the charged condenser becomes short-circuited and a current surges back and forth through the circuit containing the condenser, the control gap and the low tension side of the oscillating transformer, each surge of current being less in value than the preceding surge until the surges cease.

The real functions of the charged condenser is to give additional energy and power to the discharge spark, inasmuch as it is quite possible for the control gap to arc over without the condenser. The oscillating transformer proper thus merely steps up the high frequency voltage to the test values desired at the sphere gap. The air core is employed, as iron cannot be used with such high frequencies, and this transformer is immersed in oil to increase the insulation of the winding. A discharge takes place for every alternation of the generator wave. A 60 cycle generator thus gives 7,200 discharges of high frequency per minute.

Italian Passenger Locomotives.

The Italian government, or rather what is called the Italian State Railway, has been studying electrification and has been operating electric locomotives for several years.

The first locomotives were of the light passenger and freight type and were built



TYPE OF ELECTRIC LOCOM[illegible]

for the Valtellina lines; two heavier locomotives for heavy passenger and freight work and for operation on heavy grades were built.

The State Railway designed and had built by the Italian Westinghouse Co. several locomotives of the 0-5-0 type. These locomotives have given wonderful service and have tripled the capacity of the mountain roads as compared with the steam operation.

Additional locomotives of the 0-5-0 type, designed for high speed passenger service, are now being delivered, these locomotives also being built by the Westinghouse Co. The new locomotives are especially fitted to this type of service for they have lightness, simplicity, high [illegible] which vary from 23.3 to 62 miles per hour.

Each locomotive has two motors of 1,300 horsepower, each of the three-phase induction type. As we know the three-phase motor is a constant speed motor and the locomotive fitted with this type of motor will operate at constant speed regardless of the load or of the grade. It is possible to change the speed by changing the number of poles of the motor and the electrical windings are put on so that it is possible to do it. This particular locomotive has four speeds, namely 23.3, [illegible]

Specifications for Steel Rails.

Robert W. Hunt & Company, engineers, have published a very useful pamphlet on specifications for steel rail manufacture. In it are included the standard specifications for steel rails adopted by the American Railway Association, May 20, 1914; the standard specifications of the American Society for Testing Materials, adopted September 10, 1914; the Manufacturers' Standard Specifications for Open-Hearth Rails, dated 1914; the Manufacturers' Standard Specifications for Bessemer Steel Rails, dated 1914 [illegible] Standard Specifications for Open-Hearth Steel Rails, dated February, 1913. In addition there is a tabular detailed comparison of common rail sections, including sections of the A. R. A., the A. S. C. E., the Pennsylvania R. R., the Lehigh Valley R. R., the Canadian Pacific Ry., the A. T. & S. F. Ry., the Chicago & Northwestern Ry., the Canadian Northern Ry., the Harriman Lines, the Great Northern Ry., the Denver & Rio Grande R. R., and the Dudley sections. Another tabulated statement gives the section number for common sections of the standard rails of each of the above, from each mill. The pamphlet is for free distribution upon request [illegible] & Co., in Chicago, New York, Pittsburgh, St. Louis, San Francisco or Montreal.

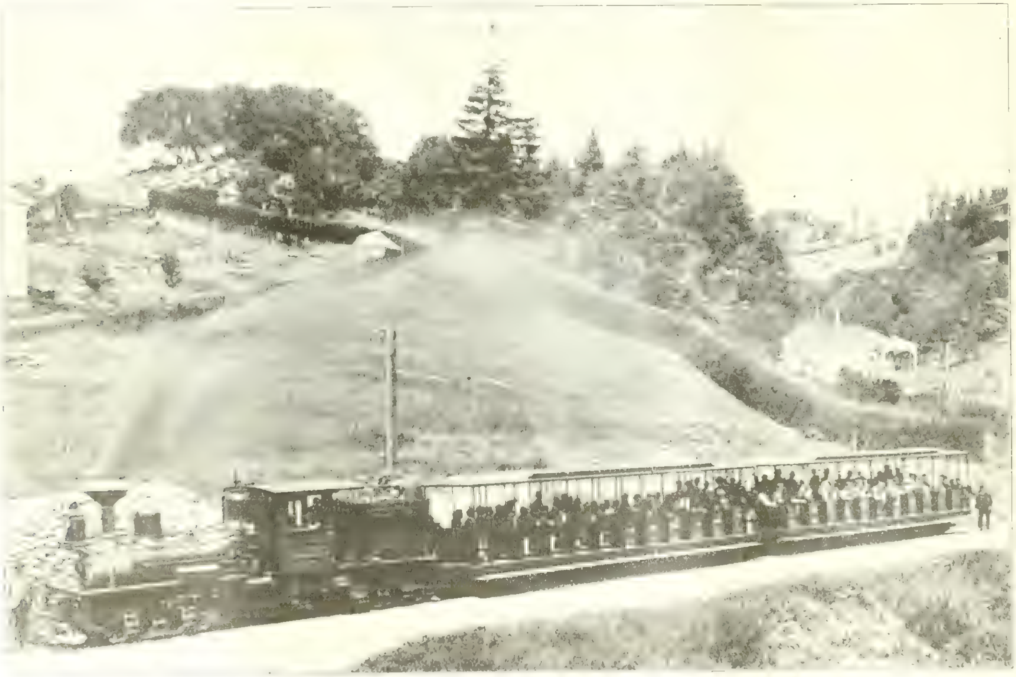
The Shay Geared Locomotive

Its Origin and Rapid Rise Into Popular Favor

Crossing the American Continent east or west by different routes every variety of locomotive is encountered, and it is surprising how new they look in spite of the strenuous service and in spite of the depressing conditions under which American railroads are compelled to operate. Among the most interesting that come in view are the Shay geared locomotives. They appear quite frequently on the forest districts, and it will be remembered that they were introduced by Mr. Ephraim Shay, an enterprising American lumber [illegible] 1873. He operated an extensive saw mill at Haring, in the center of the Michigan lumber country. The dif- [illegible] problem. Horse power was slow and costly, and the ingenious saw mill proprietor worked out his own solution of [illegible] motive, where the power might be transmitted through shafting and gear wheels [illegible] sat vertically, while the piston rods, extending downwards, were connected to a flexible shaft, extending longitudinally alongside the truck wheels, and gearing with the latter through bevel and pinion wheels.

In a short time Mr. Shay's idea became popular in lumber traffic, and he wisely transferred his patents to the Carnes Agerter Company and the Lima Locomotive and Machine Company, since amalgamated and now known as the Lima Locomotive Corporation, of Lima, Ohio. The invention was developed very rapidly along approved locomotive lines. Its [illegible] curves is remarkable. It will climb banks ranging from 1 in 33 to 1 in 7, and will negotiate curves of 50 to 100 feet radius, conditions which cannot be accomplished by any other type of locomotive with [illegible] might be expected its sphere of service rapidly widened, and it has passed to other spheres of useful activity. Its chief peculiarity is its enormous power at slow rates of speed, and its flexibility in turn- [illegible] its qualities is that upon Mount Tamalpais [illegible] grades and sharp bends of this sight seeing line are overcome by the geared locomotive.

Many of the modern types of this locomotive are large and powerful engines, among the most notable being those designed for the Kansas City Southern in connection with the operation of the new terminals of this system, which are located on the north side of Kansas City, Mo. These locomotives are of standard gauge with three cylinders 18 inches in diameter by 20 inches in length of stroke, and driving wheels 48 inches in diameter, and a steam pressure of 200 pounds. The locomotive weighs 160 tons, and was designed to haul a train of 200 tons up a grade of 1 in 14.28 on which there are [illegible] than 100 feet [illegible]



[illegible] LOCOMOTIVE AT [illegible] RAILWAY IN CALIFORNIA.

Mr. Shay's original ideas are still maintained—the vertical cylinders are placed on the side, and are geared with each wheel by a flexible shaft, so that each wheel becomes a driver, and all the weight of the locomotive and tender is disposed over the driving wheels, and in spite of the fact that the Mallet articulated and other duplex and even triplex forms of powerful locomotives have appeared since the

introduction of Mr. Shay's geared locomotive, it is still preferred for service under conditions closely analagous to those for which it was first designed, and bids fair to maintain its supremacy on its chosen field of activity.

The Speed Control Signal System for the New York Municipal Rwy. Car

New York City at the present time is undergoing great changes as far as its transportation facilities are concerned. New subways and elevated lines are being built, and old elevated lines are being reconstructed for three tracks. One of the two railway companies, the New York Municipal Railway Corporation, has designed, and already had built, a new steel car for this subway and elevated service. The car is all steel, and is specially designed for the rapid transit service. Six doors are located on each side so as to provide a means for rapid loading and unloading. There are many novel features connected with the car, and one of the most interesting is the speed control system.

In the case of rapid transit service in subways and on elevated lines, it is necessary to run at high speeds and on very close headway, very much closer than in any steam service. To meet this kind of service, and provide the best protection to the traveling public, the cars have been equipped and the roadbed laid out for the speed control signal system as described below, and being installed by the General Railway Signal Company.

Each car is equipped with a cab signal system indicating to the engineer, or motorman as he is called, when brakes should be applied or when speed can be resumed; what the permissible speed is at curves, cross-overs or special work where speed restrictions exist; and what distance is available for braking. In connection with these cab signals is the speed-control apparatus which automatically applies the brakes if the motorman disregards the cab signals and continues at the same speed.

The cab signal system consists of two lights, one green, the other yellow, and a buzzer. The green light burns when two blocks ahead are clear, the yellow light when the second block ahead is occupied, but the first block is clear, or when speed restrictions exist. The buzzer is connected with the speed control apparatus, and is used to warn the motorman that speed of train must be reduced or brakes will be applied automatically. If the cab signals are followed the speed-control apparatus does not function.

ONE OF THE EARLIEST SHAY GEARED LOCOMOTIVES BUILT BY MR. EPHRAIM SHAY FOR LOGGING IN MICHIGAN

On long, straight stretches away from the congested part of the lines the signal and speed control may be "cut-out," and at such times there will be an indication of this fact in the cab. The signal and speed apparatus will be "cut-in" to the circuit by means of ramps located between or adjacent to the tracks, the ramps operating plungers carried on the trucks.

The ordinary railroad signal system using automatic stops depends upon a lap so that space is allowed beyond the signal of sufficient distance in which the train will be brought to a stop when the emergency brakes are applied when passing the danger signal at full speed. This overlap means the greater spacing of trains. This new system is such that the automatic application of the brake occurs in the block itself, and the distance from the signal which the brakes will apply automatically depends upon the speed at which the train is moving.

The emergency braking curve of the train is known, and also the service braking curve, the service curve requiring more distance in which to stop the train at a given speed. The distance required to stop the train at the signal depends on the speed at which the train is running, so that a train running at only 20 miles per hour can approach nearer the signal before the emergency brakes need be applied than if the train was running at forty miles an hour, the first speed requiring about 150 feet for emergency braking, and about 250 for service, whereas the second speed will require about 600 feet for emergency and about 900 feet for service.

This new system then, to be effective, must take account of the speed of the train so that emergency brakes will be applied depending on the speed and at a distance from the signal such that the train will be stopped at or before the signal. In order that the motorman will be fully informed as to when he is approaching this braking curve, the buzzer is connected so that sufficient time is given for the service application of the brakes to be made and the train brought to a stop, or in case of curves, etc., that the train speed is reduced, without brakes being applied in emergency. As long as the motorman keeps the speed of the train under the emergency curve, brakes will not be applied in emergency, but if he does not pay attention to the buzzer signal and allows his train to proceed at the speed he may be running, brakes will apply in emergency, so as to bring the train to a stop in the block.

The track is divided into blocks, each block fed from a transformer, as in the usual signal systems. The transformer supplies power for operating relays in the car and energy is obtained, depending on whether the block ahead was occupied. If block ahead is clear the current from the transformer will operate the relay on the car and prevent the speed control mechanism, as described below, from operating, since the automatic feature is not needed.

With a danger block ahead, when train enters block the ramp cuts in the speed control mechanism. The rotation of the car wheels drives a cam through bevel gears, this cam being shaped to correspond to the braking curve. Contacts are provided so that if speed is not reduced brakes are applied. On passing out of the block the cam returns to its original position, ready for the next operation.

Aviation in Java.

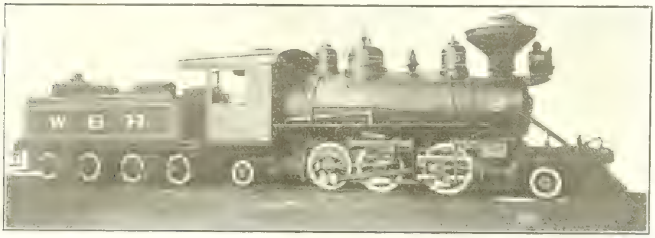
That considerable difficulties beset the airman in Batavia is proved by the following delightful extract from the *Java Times*: "Mr. Kuller again failed yesterday to persuade his machine to go. The thing jibbed shortly after starting, and the pieces will take some putting together, especially as some of them were annexed by the crowd as mementoes. The mounted police, or rather soldiers, were decidedly ornamental, and followed the tactics usual on such occasions.

Locomotives Recently Constructed for Logging Purposes by the Baldwin Locomotive Works

Some of the most interesting locomotives constructed are those built for privately operated railways, such as logging and industrial lines. The conditions to be met are often most unusual, and the locomotives must be designed accordingly.

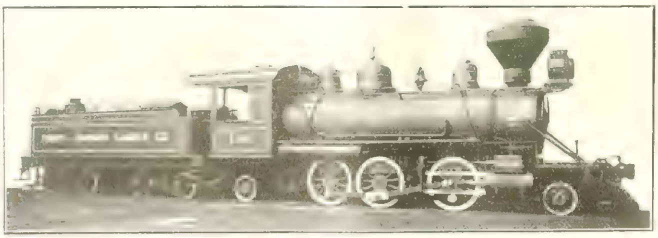
The logging industry is one of the [illegible] in logging operations of any magnitude, a railway is practically indispensable. The steam locomotive, because of its flexibility and the ease with which it can be fitted to meet unusual conditions, is the most suitable type of power for this class of work. In cases where there is a comparatively long haul from the woods to the mill, the conditions approximate those found in road service. The locomotives, however, must be suitable for work on steep grades, sharp curves and poorly surfaced track, and must be capable of remaining in service, with a minimum amount of attention and repairs. Frames and spring rigging should be strongly built, as such parts are subjected to severe stresses. The logging line almost invariably connects with a railway line, and it is usually of standard gauge so that rolling stock can be interchanged. Owing to the large amount of heavy grade work which logging locomotives must do, liberal steaming capacity is an important feature. The wheel-base must be flexible; while the wheel loads are as a rule limited, on account of light tracks and bridges.

The illustrations show four designs of logging locomotives recently built by the Baldwin Locomotive Works. The wheel arrangement in each case, incorporates leading and trailing trucks; this plan having proved most suitable, because of the excellent steaming and tracking qualities which can be combined in a locomotive so constructed. The 2-6-2 type is one of the most successful designs of locomotive ever introduced for logging service, and it has been built to cover a wide range in tractive force and capacity. The front truck is center bearing and is equalized [illegible] while the rear truck, which is side bearing, is equalized with the second and third pairs. The boiler has a comparatively long waist and a deep firebox placed back of the rear driving-wheels. This plan is suitable for burning either bituminous coal or wood; the latter fuel being frequently used on logging roads.



[illegible]-2 PRAIRIE TYPE LOCOMOTIVE FOR W. B. HARBESON LUMBER CO.

The locomotive for the W. B. Harbeson Lumber Co. has 15 in. x 24 in. cylinders and driving-wheels 44 in. in diameter. With a boiler pressure of 180 pounds, the tractive force exerted is 18,800 pounds. The fuel used is wood and the boiler has a heating surface of 1,074 square feet. The prevention of spark throwing is essential in logging work, and the locomotive is equipped with a Radley and Hunter stack, which is one of the most efficient spark arresters ever devised. Saturated steam is used, and is controlled by balanced slide valves driven by Walschaerts motion. The brakes are operated by steam, and the couplers are of the M. C. B. type.



[illegible] OST JOHNSON LUMBER CO.

The second illustration shows a somewhat larger locomotive of the same type, for the Frost-Johnson Lumber Co. This engine has 16 in. x 24 in. cylinders, and with driving-wheels 47 in. in diameter and a steam pressure of 180 pounds, the tractive force exerted is 20,000 pounds. This locomotive is also a wood burner, and the boiler has a total heating surface of 1,508 square feet. The Stephenson link motion is used, but as the wheels are comparatively small the gear is easily accessible. The equipment includes air-brakes; also three-pocket draw-castings, with M. C. B. couplers in the top pockets. The total weight of the locomotive is 101,600 pounds, of which 81,800 pounds are carried on the driving-wheels.

Mikado type locomotives are proving highly satisfactory in logging service, where conditions are such that the weight necessary for adhesion cannot be safely carried on three pairs of driving-wheels. The two locomotives of this type which are illustrated herewith, are both being exhibited at the Panama-Pacific International Exposition. Engine 41,700 was built especially for exhibition purposes. It is an oil-burner, and has a long firebox placed above the engine frames. Saturated steam is used, and is distributed by balanced slide valves driven by the Stephenson link motion. The cylinders are 18 in. x 24 in., and the driving-wheels have a diameter of 44 inches. With a steam pressure of 180 pounds, the tractive force exerted is 27,000 pounds. The total heating surface is 2,108 square feet. The engine carries 110,350 pounds on driving-wheels, and the total weight, exclusive of tender, is 138,550 pounds. This locomotive can be safely used on rails weighing 56 pounds and over per yard, and it will operate on curves of 30 degrees and grades up to 7 per cent.

The locomotive for the McCloud River line is being exhibited by the Railroad Company. This road diverges from the Shasta route of the Southern Pacific Co. at Sisson, California, and encircles the base of Mt. Shasta, penetrating the white and sugar pine forests of the McCloud River basin. The track is laid with 60-pound rails, and there are grades of four per cent. and curves of 18 degrees. The locomotive is an oil-burner, equipped with superheater, and it represents the most modern type of power thus far introduced for logging service. The cylinders are 20 in. x 28 in., and with 48-inch driving-wheels and a steam pressure of 180 pounds the tractive force exerted is

35,700 pounds. The driving wheels carry 142,400 pounds, and the total weight of the locomotive, exclusive of tender, is 178,700 pounds. The boiler has a wide firebox, and it contains 2,475 square feet of water heating surface and 519 square feet of superheating surface. In comparison with the heavy Mikado type locomotives used on trunk line railways, this engine is comparatively light; but it is as heavy a Mikado as can be safely used on this line, and is capable of developing a high percentage of its maximum tractive force for sustained periods of time.

The use of oil for fuel is meeting with favor on logging roads where a supply is easily available, as no sparks are thrown and fire risks are eliminated.

Powdered Fuel.

Electrification of the railroads in Chicago and elsewhere, promises to be pushed far into the future, if not entirely dismissed from present consideration, if the developments in the adaptation of powdered coal as a fuel realize their promise.

Close attention of railroad officials attending the seventh annual convention of the International Railway Fuel Association now in session at the Hotel LaSalle, was given this subject today, as a result of a paper on the use of powdered coal as a fuel for locomotives and stationary steam power plants, read before the meeting by W. L. Robinson, supervisor of fuel consumption of the Baltimore & Ohio Railroad, and the discussion which followed, during which Joseph Harrington, Chief Consultant of the Board of Engineering Research in Steam Power Production of the Powdered Coal Engineering and Equipment Company of Chicago, and a noted authority on combustion and steam power production, suggested the foregoing startling possibility.

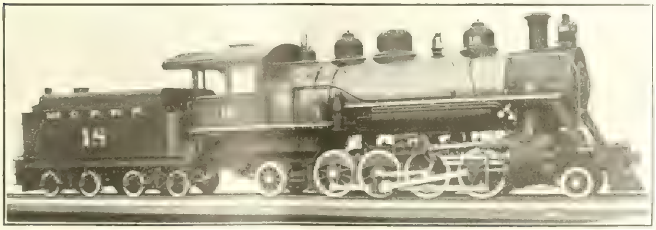
It appears that powdered coal is almost universally used in cement plants, and that it has a more or less extended use in other departments of heat production, but that until recently its application to steam power plants and locomotives has been given little or no attention.

The increasing fuel bill of the railroads, the demands for smoke abatement by the various municipalities, and the insistent urging of electrification to overcome smoke production and its attendant evils, together with the present unsatisfactory status of the finances of the railroads, have led to a painstaking search for a cheaper fuel and a general study of the fuel problem in all its aspects. The exhaustive tests made with powdered coal, it is said, promise tremendous, far-reaching economies and revolutionizing results in fuel consumption.

The essential advantages of electrification, according to Mr. Harrington, are all secured through the use of powdered coal with the added advantage in favor of the latter through the elimination of the dangers involved in the distribution of high voltage currents over extended areas subject to public contact.

MIKADO [illegible] OIL BURNER

Electrification is primarily urged because it eliminates smoke, soot, cinders, sparks and excessive noise. As compensation for the cost of electrification, the losses occasioned by these elements are saved with resulting economy to the railroads regardless of whether or not the requisite power is afforded more efficiently at less cost.



2-8-2 TYPE LOCOMOTIVE FOR THE McCLOUD RIVER LINE

It was pointed out, however, that the use of powdered coal by locomotives will also eliminate smoke, soot, cinders and sparks, and that by reason of the radically different methods of combustion requisite to the use of powdered fuel, draft and exhaust mufflings are easily accomplished, thus eliminating the objectionable noises due to locomotive operation. Hence all the essential advantages of electrification are met by the use of powdered fuel.

"The enormous sum of $190,000,000 which it is suggested will be required to electrify the railroads within the city of Chicago alone," said Mr. Harrington, "is staggering, especially in view of the present status of railroad finances, and even though it can be distributed among twenty-five railroads, its expenditure would have to be extended over a considerable period to at all admit of its present consideration. Yet there is an insistent and ever pressing demand on the railroads for the elimination of most of the evils that would be cured by electrification, and the only inducement held out to the roads is the comparatively small saving on their enormous investment in a limited area, much of which is offset by the requirements of operating an interrupted double standard of transportation power, and with little hope that a single uninterrupted standard for the whole system can ever be a possibility.

"Furthermore, no one questions the fact that an interrupted double standard system of power can in no sense be as efficient and economical as a single uninterrupted standard. That is to say, if the entire power system of a road be electricity, or steam, or gasoline, much greater economy and efficiency is inevitable than where a combination of different forms of power is required. To electrify the railroads of the United States is not a conceivable present financial possibility.

"When it is understood that a new electric locomotive of 50,000 pounds tractive effort costs approximately $50,000, and that all the present locomotives in use by the roads can be equipped to use powdered coal at a cost not exceeding $4,500 per locomotive, thus affording a single uninterrupted power system for the whole property, the financial advantages of adaptation for powdered coal as a fuel as against electrification are a most potent and mighty factor.

"The advantages, not only to the railroads, but to the whole public as well, resulting from an avoidance of electrification with its attendant interruption and disturbance of transportation, and the chaotic conditions to be struggled with during the long period of construction, are so patent, so enormous, so incomparable, that it is incredible that the general public will not hail with delight its avoidance of a condition to be tolerated only for the final achievement.

Items of Personal Interest

[illegible] of the Niles-Bement-Pond Co.

Mr. H. Osborne has been appointed manager of the Canadian Pacific shops, with office at Montreal, Que.

Mr. C. E. Farley has been appointed [illegible] with office at Goodland, Kan.

[illegible]

Mr. V. E. Hunter has been appointed general foreman of the Texas Midland at Terrell, Tex., succeeding Mr. A. C. Miller.

[illegible] electrical engineer in the car lighting de- [illegible] Topeka, Kan.

Mr. E. L. Myers has been appointed to take entire charge of the railway sales and service of the Willard Savage Battery Co. in the southwest.

Mr. Edward C. Brown has been appointed to take charge of the new office opened by the Dearborn Chemical Co. in Buenos Aires, Argentina.

Mr. J. R. Wells, formerly supervisor [illegible] joined the sales force of the National Carbon Co., Cleveland, Ohio.

Mr. J. W. White, formerly of the Union Switch & Signal Co., has resigned to become special representative of the Electric Co., Bridgeport, Conn.

Mr. Charles Spalding, representative of the Gesholt Machine Co., Madison, Wis., has transferred his headquarters from the Chicago office to Detroit, Mich.

Mr. M. E. Sherland, formerly master boiler maker of the Iron Mountain Railway at McGehee, Ark., has resigned to become postmaster at that point.

Mr. G. A. Mitcham has been appointed [illegible] Grande, with office at Ogden, Utah, succeeding Mr. M. C. Reed, resigned.

Mr. W. C. Sealy has been appointed master mechanic of the Ontario lines of the Grand Trunk, with offices at Toronto, Ont., succeeding Mr. J. Markey, deceased.

Mr. A. J. Poole, formerly superintend- [illegible] nal Oil Co., with headquarters at Atlanta, [illegible]

Mr. A. H. Powell, formerly master mechanic of the Western Pacific at Sacramento, Cal., has been appointed general master mechanic, with offices at Sacra- [illegible]

[illegible] Macbeth has been appointed superintendent of motive power of the New York, Chicago & St. Louis, with offices at Cleveland, Ohio. Mr. Macbeth succeeds Mr. E. A. Miller, deceased.

Mr. R. J. Hinkle has been appointed general manager of the Mississippi, Hill City & Western, with office at Hill City, Minn., succeeding Mr. W. W. Rabey, resigned.

Mr. H. M. Muchmore has been appointed general foreman of the Santa Fe at Clovis, N. M., and Mr. W. H. Kushera has been appointed general foreman of the same road at Deming, N. M.

Mr. D. E. Burton, formerly master mechanic on the Santa Fe, at Argentine, Kan., has again assumed the duties of bonus supervisor, with office at Topeka, Kan.

Mr. W. H. Winterrowd, mechanical engineer of the Canadian Pacific at Montreal, Que., has been appointed assistant to the chief mechanical engineer, with office at Montreal, Que.

Mr. W. P. McDevitt, formerly general foreman of the Southern at Macon, Ga., has been appointed master mechanic of the Kentucky & Indiana terminal, with office at Louisville, Ky.

Mr. C. E. Brooks, formerly general foreman of the Grand Trunk Pacific at Transcona, Man., has been appointed acting superintendent of motive power, with offices at Transcona, Man.

Mr. E. A. Hadley, formerly assistant engineer of the Missouri Pacific and the St. Louis, Iron Mountain & Southern, has been appointed chief engineer, with headquarters at St. Louis, Mo.

Mr. N. J. Frenzer, formerly master boiler maker of the Santa Fe shops at Amarillo, Tex., has been appointed to a similar position on the same road at Clovis, N. M., succeeding Mr. C. G. Duffy.

Mr. E. J. Roth has been appointed purchasing agent of the Chicago, Indianpolis & Louisville, with offices at Chicago, Ill., succeeding Mr. Frederick Davidson, and will have jurisdiction over purchases and [illegible]

[illegible] Rock Island at Horton, Kan., has been appointed machine foreman and retains charge of the tool department. Mr. Blane Sutton has been appointed erect- [illegible]

Mr. E. E. Winship, formerly manager of the Cincinnati branch of the Manning, [illegible] manager of the Cleveland branch, and Mr. C. H. Overkamp succeeds Mr. Winship as manager of the Cincinnati branch.

Mr. W. B. Carnes, formerly in charge of the New York office of the Lima Locomotive Corporation, has been appointed Western representative, with office in the McCormick building, Chicago, Ill., and Mr. William T. Middleton succeeds Mr. Carnes in the New York office.

Mr. G. W. Cuyler has been appointed roundhouse foreman of the Rock Island at Silvis, Ill., and P. F. Harris has been appointed to a similar position on the same road at Estherville, Ia., and Mr. J. H. Mullinix has received a similar appointment at Manlay, Ia.

Mr. O. E. Selby has been appointed principal assistant engineer of the Cleveland, Cincinnati, Chicago & St. Louis, and Peoria & Eastern, and Mr. J. B. Hunley has been appointed engineer of bridges and structures on the same roads, succeeding Mr. O. E. Selby, promoted.

Mr. A. J. Wilson has been appointed roundhouse foreman of the Santa Fe at Clovis, N. M., succeeding Mr. E. W. Tucker, assigned to other duties, and Mr. Carl Miller has been appointed assistant roundhouse foreman, succeeding Mr. George Roach, assigned to other duties.

Mr. William Marshall has been appointed assistant manager of telegraph of the Canadian Pacific, with headquarters at Winnipeg, Man., and Mr. H. J. Lille has been appointed superintendent of telegraph on the same road, with office at Toronto, Ont., succeeding Mr. Marshall.

Mr. John Kirk, formerly superintendent of terminals of the Elgin, Joliet & Eastern at Gary, Ind., has been appointed superintendent of the Gary division of the same road, with office at Gary, Ind., and Mr. C. H. Dorley, formerly assistant superintendent of terminals at South Chicago, Ill., has been appointed superintendent of terminals at East Joliet, Ill.

Mr. Jesse G. June, formerly superintendent of terminals of the Erie at Jersey City, N. J., has been appointed superintendent of the Allegheny and Bradford divisions of the same road, with office at Salamanca, N. Y., succeeding Mr. Frederick Hawley, deceased, and Mr. Eugene R. Allen, formerly assistant superintendent of terminals at Jersey City, succeeds Mr. [illegible]

Mr. H. W. Thornton, formerly general superintendent of the Long Island Railroad, now general manager of the Great Eastern of England, has "made good." The statement came in a press despatch from Londan last month, saying that at the annual meeting of the shareholders of the Great Eastern, Lord Claud Hamilton, the chairman of the company, paid Mr. Thornton a special tribute; and that the meeting unanimously agreed that Mr. Thornton, already, before filling out a year's service, had fairly justified his selection as manager.

The Mechanical Side of Railroading

Its Difficulties Explained by W. Schlafge, Supt. of Motive Power of the Erie

Mr. William Schlafge, superintendent of motive power of the Erie railroad, in addressing one of the railroad societies in New York City, recently said, among other things, that the mechanical side of railroading produces no income, it sends no actual cash into the treasury regardless of what it may keep from going out. Its mission is, to do its part, to keep the instrumentalities of commerce in shape to earn revenue. Each passenger locomotive may earn, approximately, $3,700, and each freight locomotive, $52,000 per annum, but the sad truth ever confronts the mechanical man that, from 20 to 25 per cent. of all operating expense, is laid up against him. He is a good spender and he is always "broke." His stories therefore are apt to be of the hard luck variety and they are received with the same cordial enthusiasm, that a subscription paper to buy the Kaiser a loving cup would be received in London, or as the solicitation, of a similar token of affection for King George, would be received in Berlin.

The mechanical man makes up a modest programme for a new roundhouse at one point; two or three modern coal and ash handling plants; a couple of new power plants; perhaps a new shop; a hundred new machines and a job lot of fifty thousand dollars' worth of small tools and miscellaneous things regarded as useful in his business. When the hard-hearted management makes a few minor revisions of his plans he cheerfully accepts the allowance, builds an extension to several stalls of the old roundhouse, to house the big engines, puts new flues in the boilers of the much-slandered power plants, gives the old shop a coat of whitewash inside, forgets the rest and like a true railroad man settles down to do business with what he has, as better men have done before him and will do after he has gone. After all, he reasons, there is something to be thankful for. If something had to be cut off, far better the improvements than his head. Then, if he is somewhat of a philosopher and given to rather fanciful speculation, he may occasionally dream, and even pray, that a certain high administrative body at Washington may get religion, because when men get religion, the hereafter is illuminated with a brightness never before realized and they hasten to make reparation for the wrongs and misdeeds done in their days of evil. He well knows that complete reparation would cause the improvements he recommended to appear in a different light and might even make possible those bridges the maintenance of way people have been after so long and the ties and rails needed so badly.

All railroad men know that railroad work, beyond question, is very interesting. It is frequently remarked that there is something about the life, which attracts and holds, men with greater force than its material rewards. If we seek far enough the reason will be found in that lofty, and exacting, attribute of human nature which withholds contentment and satisfaction from the normal man unless he can feel himself a part of the world's real work. It is not ambition, for ambition is not always worthy and sometimes is even sordid and mean. It is rather that vital and deathless something of soul life, deep rooted in character, that gives off only inspiration and

WILLIAM SCHLAFGE

courage. It is that same force that sustains and disciplines real men to find their chief reward in work well done and in efforts well directed to ends worth while.

Railroad work surely has a high place in the activities which most benefit mankind, and it is not strange, that men should find the field attractive. Recalling our subject on this occasion. It is believed that the mechanical side of railroading is, at least, as interesting, as attractive and as fascinating as any other branch of the service.

But I would not have you get the impression that I am speaking as a mechanical man. Rather would I have you think [illegible] tolerance for departmental distinctions. Departmental lines are very proper and necessary, to fix the lines of responsibility and for the orderly and effective conduct of business, but no further. [illegible] trite to say that all energies that are not directed toward the ultimate and [illegible] mate ends of any business, are wasted or at least impaired. That end in the railroad business is to sell transportation at a decent profit and everything which diverts energy, that the business is taxed to create, from that object is a thing to be weeded out. This thought may be illustrated by picturing a wide stream in whose course, at a certain point, it must pass through a long narrow gorge. On the upstream side the waters are collected by various tributaries from hundreds of square miles of drainage area. The stream gains in volume until, at the narrows, the waters pile up and develop a tremendous, concentrated energy of well nigh resistless force capable of being transmuted to the untold benefit of mankind. On the down stream side the waters spread out again into a wide, placid, and perhaps sluggish, stream, as if tired by their demonstrations of energy passing through the gorge. The one shows the cumulative effect of the concentration of energy; the other of its dissipation.

Erie's Triplex.

The triplex compound locomotive which the Erie Railroad Company bought from the Baldwin Locomotive Works last year is doing remarkably good work as a pusher out of Susquehanna, Pa. The engine is reported to be doing the work that it took four consolidation engines to accomplish. The cost of repairs so far is about equal to what would be called for by one Mallet engine.

Improved Aeroplanes.

Swifter aeroplanes, lighter aeroplanes, aeroplanes that go higher or carry greater weight, are no longer the chief objects of those inventors whose specialty is the development of aeronautics. Safer aeroplanes are urgently needed, and, according to Henry Woodhouse's recent article in the Bulletin of the Aero Club of America, these are now being made. The movement for safety in aviation, he says, is daily gaining. "It has introduced steel for general construction, heavy wheels and reinforced, improved skids, strong cables for trussing, double cables for controls, better joints, turnbuckles, bolts and gen- [illegible]

The Pennsylvania is asking for bids on [illegible] passenger cars and has issued inquiries for 1,500 gondolas, 4,919 coal and coke, and 1,000 box cars. The company will also build 2,326 cars in its Altoona shops [illegible] 102 flat cars.

Railway Master Mechanics' Association.

The forty-eighth annual convention of the American Railway Master Mechanics' Association will be held at Atlantic City, N. J., beginning on Wednesday, June 9, and continuing during the succeeding two days. Mr. F. F. Gaines, S. M. P. Central of Georgia, is president; Mr. E. W. Pratt, A. S. M. P., Chicago & Northwestern, first vice-president; Mr. Wm. Schlafge, Gen. M. S. of the Erie, second vice-president; Mr. F. H. Clark, G. S. M. P. of the Baltimore & Ohio, third vice-president; Dr. Angus Sinclair, treasurer, and J. W. Taylor, Karpen building, Chicago, Ill., secretary.

The executive committee, which, in addition to the officers, includes the names of Messrs. C. F. Giles, S. M., Louisville & Nashville, and M. K. Barnum, Gen. M. S., Baltimore & Ohio, have made excellent arrangements for the convention, and among their other duties selected the personnel of the committees who will present reports on the various subjects assigned to them. The subjects embrace: Revision of Standards and Recommended Practice; Mechanical Stokers; Smoke Prevention; Fuel Economy; Design, Construction and Inspection of Locomotive Boilers; Joint Meetings A. R. M. M. Association and M. C. B. Association; Locomotive Headlights; Safety Appliances; Standardization of Tinware; Locomotive Counterbalancing; Maintenance and Operation of Electric Equipment; Revision of Air Brake and Train Signal Instructions; Boiler Washing; Dimensions of Flange and Screw Couplings for Injectors.

In addition to reports on these subjects an individual paper on Alloy Steel will be presented by Mr. S. M. Vauclain, V. P. Baldwin Locomotive Works, Philadelphia, Pa., and also a paper on Variable [illegible] Bell, New York City.

Master Car Builders' Association.

The forty-ninth annual convention of the Master Car Builders' Association will be held at Atlantic City, N. J., on June 14, 15 and 16. The officers are: President, Mr. D. F. Crawford, Gen. S. M. P. of the Pennsylvania Lines West; Mr. D. R. McBain, S. M. P. of the Lake Shore & Michigan Southern, first vice-president; Mr. R. W. Burnet, Gen. M. [illegible] second vice-president; Mr. C. E. Chambers, S. M. P. Central of New Jersey, third vice-[illegible] and Mr. J. W. Taylor, Karpen building, Chicago, secretary. Messrs. R. E. Smith, Atlantic Coast Line; J. C. Fritts, of the Lackawanna, and H. F. Bentley, of the Chicago & North Western, members of the mittees will report include: Arbitration; Revision of Standards and Recommended Practice; Train Brake and Signal Equipment; Brake Shoe and Brake Beam Equipment; Couplers; Loading Rules; Car Wheels; Safety Appliances; Car Construction; Specifications and Tests for Materials; Car Trucks; Prices for Labor and Material; Train Lighting and Equipment; Nominations; Tank Cars; Settlement Prices for Reinforced Wooden Cars; Compensation for Car Repairs; Draft Gear, and Joint Meetings of the Master Car Builders and Master Mechanics' Associations.

It will thus be seen that the order of business embraces an extensive variety of subjects, and the committees have been carefully selected from among the members who by experience are eminently qualified to present reports that cannot fail to be of much value to the members of the association and railway men generally.

Railway Supply Manufacturers' Association.

The Railway Supply Manufacturers' Association are completing arrangements as formerly for an extensive exhibit at Atlantic City during the conventions of the Master Mechanics and Master Car Builders' Associations. The officers are Mr. J. Will Johnson, Pyle National Electric Headlight Company, president; Mr. Oscar F. Ostby, Commercial Acetylene Railway Light and Signal Company, vice-president. The members of the executive committee include Mr. C. E. Postlethwaite, Pressed Steel Car Company, and Mr. P. J. Mitchell, of Phillip S. Justice & Co., third district; Mr. George H. Porter, Western Electric Company, fifth district, and Mr. Frank E. Beal, Magnus Metal Company, sixth district.

Railway Mail Pay.

At a meeting of Railroad Executives representing ninety per cent. of the entire mileage of the country, held at the Grand Central Terminal on May 20, the question of the compensation paid the railroads for carrying the mails was discussed. Strong resolutions were adopted advocating the system of paying the railroads according to the weight of mail transported, and opposing the space plan advocated by the Post Office Department. The resolutions also embodied a request that the railroads be relieved from the duty of carrying the mails between railroad stations and post offices. [illegible] for [illegible] ment post office cars, the same as for full railway post office cars. It was also asked that the Interstate Commerce Commission have the same jurisdiction over the mail traffic that it now has over all other traffic of the railroads.

Engineering Foundation.

The first meeting of the Engineering Foundation was held at the Engineering Building, New York, on May 25, and rules of administration were adopted and the following officers elected: Chairman, Gano Dunn; Vice-Chairman, Edward D. Adams; Secretary, F. R. Hutton; Treasurer, Joseph Struthers. This is a professional engineering trust organized along the lines of the Cleveland, Carnegie, Rockefeller and Sage Foundations, by the United Engineering Society, representing jointly the national organizations of Electrical, Mining and Mechanical Engineers with the co-operation of the national organization of Civil Engineers, combining about 30,000 members. The Engineering Foundation was made possible through the generosity of a distinguished engineer, Ambrose Swasey, of Cleveland, who made the initial gift of a quarter of a million dollars to be devoted to the benefit of mankind through fostering engineering research. The board telegraphed Mr. Swasey greetings and appreciation of his generosity and pledged itself to carrying out his cherished aims. Applications for the use of funds were received in large numbers and a committee was appointed to consider them, consisting of Dr. A. R. Ledoux, Chairman; Mr. J. Waldo Smith, Dr. M. I. Pupin, and Dr. Alexander C. Humphreys. Most of the applications were in such form that they could not be considered and the committee is preparing a schedule of requirements with which applications will have to comply. The Engineering Foundation is the first of its kind devoted to engineering interests.

The Tool Foremen's Association.

The 1915 convention of the American Railway Tool Foremen's Association will be held in Chicago from July 19 to 21, inclusive, at the Hotel Sherman. The following are the topics which will be considered through committee reports and discussions: "Special Jigs and Devices in Locomotive Repair Shops"; "Safety First in Regard to Machinery and Tools"; "Maintenance of Pneumatic Tools—Special Tools and Equipment for Same"; "Grinding and Distribution of Tools in Locomotive Repair Shops"; "Standardization of Reamers for Locomotive Repair Shops"; "To Select an Emblem for the American Railway Tool Foremen's Association." The Supply Association, which meets in connection with this association, is lending its efforts to the success of the convention. The officers of the American Railway Tool Foremen's Association are: Mr. A. M. Roberts, B. and L. E. Railroad, Greenfield, Pa., president; Mr. H. Otto, A. T. & S. Fe Railway, Topeka, Kan., vice-president; Mr. A. R. Davis, Cent. of Georgia Railroad, Jacksonville, Fla., secretary and treasurer.

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RAILROAD NOTES.

The Chicago, Indianapolis & Louisville has ordered 3,000 tons of rails from the Illinois Steel Co.

The Atlantic Coast Line has ordered 6,000 tons of rails from the Tennesee Coal, Iron & Railroad Co.

The Texas State, it is reported, will build a roundhouse, car shed and coal chute at Palestine, Tex.

The Cuba Railroad has ordered 15 locomotives from the American Locomotive Co., according to report.

The Minneapolis & St. Louis has placed an order for 5,000 tons of rails with the Illinois Steel Co.

The American Locomotive Co. has taken an order for small locomotive parts for the Servian government.

The Atlantic Coast Line has ordered 6,000 tons of steel rails from the Tennessee Coal, Iron & Railroad Co.

The Russian Government, it is said, has placed an order for 17,000 air brakes with the Westinghouse Air Brake Co.

The Baltimore & Ohio and the Western Maryland will build a roundhouse, machine shop and yards at Rockwood, Pa.

The Chicago Elevated Railways have ordered 122 all-steel motor cars with Baldwin trucks from the Cincinnati Car Co.

The Chicago & North Western has placed an order for 2,000 steel underframe box cars with the Western Car & Foundry Co.

The Boston & Albany is having the American Locomotive Co. convert 10 Consolidation type locomotives to Mikado type.

The Pennsylvania has given an order to the Juniata shops to construct 50 Mikado locomotives equipped with superheaters.

The Union Terminal Co., of Dallas, Tex., has awarded contract for 215 tons of steel for train sheds to the American Bridge Co.

The Russian Government has ordered 2,000 freight cars from the Canadian Car & Foundry Co. and 2,000 from the Eastern Car Co.

The Minneapolis, St. Paul & Sault Ste. Marie has ordered 400 box and 100 steel automobile cars from the American Car & Foundry Co.

The Southern Pacific contemplates building a new station, shops and terminal tracks at Algiers, La., at an estimated cost of $100,000.

The Chicago, Milwaukee & St. Paul will build 2,000 cars in the company's shops. This road is said to have ordered 7 sleeping cars from the Pullman Co.

The Chicago & North Western has ordered 2,000 box cars from the Western Steel Car & Foundry Co. This road has also asked for bids on 10 coaches and 3 smoking cars.

The Central Locomotive & Car Works is asking bids on trucks, castings and forgings for 1,000 freight cars, it is said, in preparation for building 1,000 cars for the Minneapolis & St. Louis.

The Seaboard Air Line has let a contract to the Richardson Construction Co., Norfolk, Va., to erect temporary building for machine shops at Portsmouth, Va., in place of those recently burned.

The Chicago, Rock Island & Pacific has asked for prices on five thousand 40-ton box cars. As soon as estimates are received the receivers will ask permission to issue receivers' certificates.

The Pennsylvania Equipment Co. is in the market for 100 80,000 to 100,000-lb. capacity flat cars, a second-hand combination passenger and baggage car and 2 combination passenger, mail and baggage cars.

The Interborough Rapid Transit is in the market for 974 trucks. The Pullman Co.'s recent order for 478 subway car bodies has been approved by the New York Public Service Commission, First district.

An American consular officer in Russia reports that an engineer in his district desires to place orders for from three to seven locomotive railroad cranes, suitable for a 5-ft. gauge, having a lifting capacity of 5 tons. It is stated that these cranes are urgently needed.

The Ft. Worth & Denver City has just ordered 1,200 40-ft., 40-ton steel center sill box cars, 300 40-ft., 40-ton steel center sill stock cars, and 200, 100,000-lb. capacity, steel gondola coal cars from the Haskell & Barker Car Co.

The Atchison, Topeka & Santa Fe is reported to be taking bids for one 18-in. x 12-ft. engine lathe; one 250-lb. steam hammer; one 54-in. vertical turning and boring mill; one 42-in. vertical boring mill; and 16 x 10-ft. engine lathe; one 20 x 16-ft. engine lathe, and one 42 x 42 x 18 pattern planer.

Books, Bulletins, Catalogues, Etc.

Human Nature and Railroads.

[illegible] a book just published by E. S. Nash & Co., Philadelphia, Pa., and written by Mr. Ivy L. Lee, [illegible] Pennsylvania [illegible] of the staff [illegible] The logic of Mr. Lee's work is convincing, and the book is sure to attract much attention. [illegible] figures is masterly, and as a plea for better treatment [illegible] it takes a high [illegible] the railroad literature of our [illegible] A [illegible] sample from the work will [illegible] "Isn't it perfectly obvious that the railroad treasury is absolutely restricted to what it takes in?—it can't pay out any more than it receives. Therefore, if you constantly place burdens on the railroads, arbitrary necessities for expenses, and restrictions of all kinds, taking their money away at one point, isn't it perfectly obvious that the service is bound to be taken away from you at another point? [illegible] been found for subtracting $5 from $4.

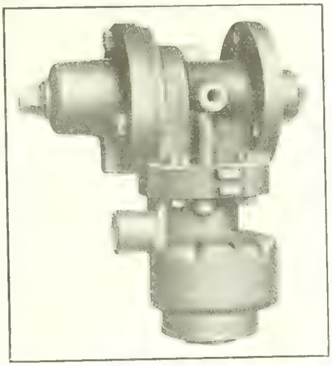
"The public is constantly passing laws designed to secure greater safety, hours of service laws, full crew laws, semi-[illegible] measures [illegible] that the public should have these laws. They may want them, but let us not for one moment imagine that these desirable ends haven't [illegible]"

Machine Design Construction and Drawing.

The author of this book, Henry J. Spooner, is professor of mechanical and electrical engineering at the Polytechnic School of London, England. The work [illegible] illustrated with 1,600 figures, and published by Long-[illegible] Thirtieth street, New York. The price is $3.50. The first five chapters are devoted to drawing and the subject is treated in a manner that the beginner will find [illegible] chapters deal with matters relating to design and [illegible] the scope of the book: "Riveted Joints," [illegible] and Hangers," "Pistons and Piston Rods," [illegible] complete chapters is that on "Materials [illegible]" Each chapter is concluded with a set of questions and suggestive drawing exer-[illegible] helpful in teaching work, it contains in-[illegible]

The Snyder "No-Kicker."

A descriptive pamphlet has been issued by the Pittsburgh Air Brake Company, Pittsburgh, Pa., presenting statistics of one hundred car train efficiency tests of the Snyder "No Kicker" attachment as applied to automatic triple valves in operation on the Delaware, Lackawanna & Western at Scranton, Pa., under the direction of Mr. P. J. Langan, Supervisor of Air Brakes. It is claimed that there are as many as forty-two reasons why the present type of automatic triple valves will go into undesired quick action, and the device described in the pamphlet will positively eliminate undesired emergency regardless of the existence of any one of the combinations of the predisposing causes, such, for instance, as a bent piston, excess friction on slide valve and piston, a sticky piston, dry slide valve, tight packing ring, [illegible] closed with dirt or otherwise. The new



[illegible]

[illegible] in service does not in any manner interfere with the quick service or other effects of such valves, but establishes a positive means for securing emergency when desired and absolutely avoiding it when not desired. Copies of the pamphlet, with full details of the tests alluded [illegible]

Oxy-Acetylene Welding and Butting.

[illegible] Calvin F[illegible] Frederick J. Drake & Co., Chicago, ex-[illegible] binding [illegible] $1 in cloth, has just been is-[illegible] it may be said that the scope of this [illegible]k is well indicated by the table of contents, which subdivides its subject [illegible] Welding, Welding

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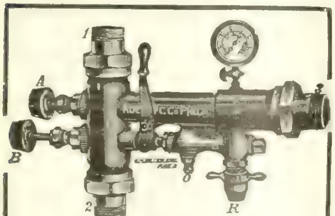

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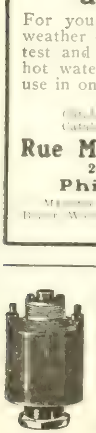

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Flames, Oxygen, Acetylene, Acetylene Gas Purification and Handling, Oxy-Acetylene Torches, Characteristics of Welding Torches, Welding Installations, Pre-Heating and Annealing, Operating a Welding Installation, Metal Welding Practice, Oxy-Acetylene Cutting, and Oxygen Carbon Removal. These chapters are covered by a well-compiled index. Important features of the work, not evidenced in the title which has been chosen for it, are the operation and care of acetylene generating plants and the oxygen process for the removal of carbon. The book is largely descriptive and is plainly for the practical man. It contains little theory, just enough to enable him to acquire a thorough understanding of the different phases of the subject. Equipment for oxy-acetylene operations is rapidly being added to shops and plants. The process is superseding a large number of old methods and is now to be found frequently in structural and general contracting work. Books upon the subject are few, and for this reason the clear presentation which this little work contains will likely receive wide appreciation.

New Map and Statistics of California Railroads.

The Railroad Commission of the State of California has just issued an official railroad map of California. The map was compiled by the engineering department of the commission, under the direction of Richard Sachse, chief engineer, and is considered very complete and accurate. It shows the routes of all railroads, both steam and electric, operating in California, the larger systems being given distinctive colors. It is printed on medium weight paper, 41 by 52 in. Mounted maps will be available shortly. The scale of the main map is 15 miles to the inch. There are small inset maps on a scale of three miles to the inch, showing San Francisco and vicinity, Los Angeles and vicinity, and San Diego and vicinity, and one of the city of San Francisco on a scale of about one mile to the inch.

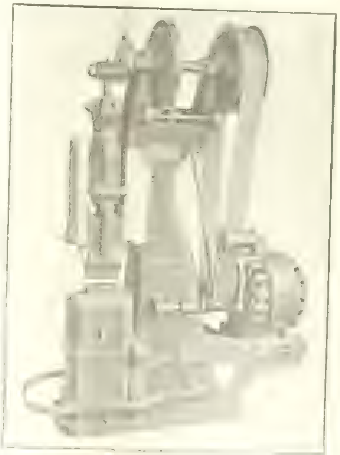
The names and mileage of all steam and electric railroads operating in the state are listed. The map also shows principal highways, oil pipe lines, steamship lines, forest reserves, township and range lines, etc.

Arch Tube Cleaners.

The Lagonda Manufacturing Co., of Springfield, Ohio, has just issued a new 12-page catalogue entitled "Lagonda Locomotive Arch Tube Cleaners." [illegible] catalogue covers the subject of scale removal from the arched tubes of l[illegible] tive water arch furnaces and describes the specially designed cleaner [illegible] purpose. Copies may be had on re[illegible]

American Made Anvils.

Among other assurances of improved conditions, it is pleasant to learn that in spite of lightning changes in tariff rates by embryo legislators, and increased freight charges which are or may be a necessity, the enterprising firm of Hay-Budden Manufacturing Company report a decided improvement in their orders for anvils made in America. It looks as if their extensive works in Brooklyn will soon be as active as ever. Referring to freight charges, it may not be generally known that anvils can be carried at a cheaper rate from Norway and Sweden to New Orleans than they can be conveyed from Brooklyn to the same point. With a tariff near absolute zero, it can readily be seen what this means—simply that the anvil trade would be confined to the north of Europe. Whether the war zone or the submarine or the new appliances of the Brooklyn firm have had the chief effect in retaining a large portion of the important trade in America, we would not care to venture an opinion, but it is always gratifying to see that means of meeting an emergency can be conceived and brought forth in the atmosphere of American enterprise.



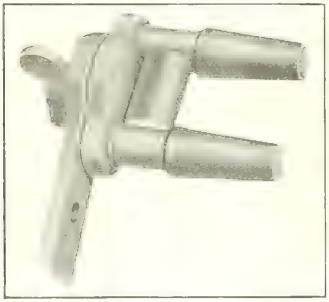
Beaudry Hammers.

The Beaudry motor-driven hammers are finding their way into railroad shops, [illegible] where the use of overh[illegible] is not [illegible] may be isolated and [illegible] from the main power plant. Several [illegible] devices may be attached to thes[illegible] to suit the [illegible] which may be me[illegible] clutch [illegible] the hammer and [illegible] same variation in speed [illegible] that is

obtained by use of loose belt and idle pulley in the belt-driven type. There is also a belt tightener attachment. The power may be alternating or direct current; also voltage, phase and cycle. Copies of descriptive catalogues may be had from Beaudry & Co., 141 Milk street, Boston, Mass.

"Safety First" Belt Shifter.

The Ready Tool Company, Bridgeport, Conn., have placed on the market a belt shifter that seems to fill the proverbial long-felt want. Climbing ladders, putting on and taking off belts by hand, or using the ordinary belt stick with a pin which has not infrequently been known to get caught, can all be avoided by the use of this device. It is simple and consists of one part to be bolted to the regulation pole, having a swivel fork attached. There are three rollers, two of them being tapered, so that there is no possibility [illegible] getting caught and no way [illegible] against the



[illegible] SHIFTER.

various parts. Two of the rollers being tapered after the belt is placed in the fork, the tendency is at all times for the belt to slide on to the pulley and for the forks to slide away overcoming entirely any possibility of accident. It is substantially made and can always be depended [illegible] belts without danger and without requiring the power to be stopped. It would pay for itself in a short time. Send for price [illegible] Tool Company, Bridgeport, Conn.

Car Repair Work.

[illegible] nine million M. C. B. repair cards are [illegible] amount of money represented in the bill- [illegible] lars. This is a considerable item and if any of it be due to incorrect billing, whether through clerical error or any sharp practice, it might be a source of real economy to take the necessary steps that each owning line may strictly check the bills for foreign repairs. It is practically impossible to do this now, since the rule that repair cards be applied to the cars has been discontinued. The suggestion has been made that sharp practices, or dishonesty, and errors, are very frequently in evidence, and that a force of special inspectors working under the M. C. B. arbitration committee be appointed to check the foreign repair work and billing thoroughly before the owning lines are required to pay. The way is open for dishonesty, the same as it is for error, but the incentive for dishonesty is so small, and the meanness of it in this relation so utterly inconceivable, that we believe the most fruitful line of endeavor is that directed against simple error. Probably a better view would be to institute some system of inspection for a period of one year, or such time as seems necessary, in order to locate the exact sources of error, and from this information it could be determined what permanent plan is advisable, so that some satisfactory conclusion to all concerned could be arrived at.

Street Locomotive Stoker.

Catalogue No. 14 B, issued by the Locomotive Stoker Company, shows over twenty high-class illustrations of the most powerful locomotives in operation on the leading railroads in America, and expressly used to show that many of the high-powered locomotives all over the country are now equipped with the Street locomotive stoker. The number of installations of the stoker on each type of locomotives is given and also the general dimensions of the locomotives, so that the catalogue is not only the best kind of testimonial to the growing popularity of the device, but is also interesting as furnishing valuable data as to the exact dimensions of the parts of almost every type of modern locomotive. We note that there are now 161 Mikado freight locomotives equipped with the Street stoker on the Baltimore & Ohio, and thirty of the Mallet pusher type, 115 of the Mallet road locomotive type on the Norfolk & Western, and again on the Chicago, Burlington & Quincy there are forty-three locomotives of the 2-10-2 type all equipped with the device. These are but a few selected at random. All interested should secure a copy of the catalogue. Apply at the general offices, Schenectady, N. Y., or at 30 Church street, New York City.

A Cautious Farmer.

[illegible] a good Alderney cow. A stranger, having admired the animal, asked the farmer, "What will you take for the cow?"

The farmer scratched his head for a moment, and then said: "Look-a-here! Be you the tax assessor, or has she been killed by the railroad?"

Pennsylvania Steel Company.

The fourteenth annual report of the Pennsylvania Steel Co. shows the effect of the year's depression in the steel trade. The interest on the bonded indebtedness and the charges for depreciation of property and exhaustion of minerals caused a deficit of $678,491. The total earnings for the year were $1,340,049, a decrease of $1,493,613. The value of products shipped last year was the smallest in fifteen years. There was expended upon upkeep $2,200,000 and for improvements $5,532,291. The management is not satisfied with this as plans are under way for new methods of increasing production.

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INSPECTORS HAMMERS
Hand Cut STEEL LETTERS & FIGURES
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Hardened All Over
Will outwear two of the soft kind.
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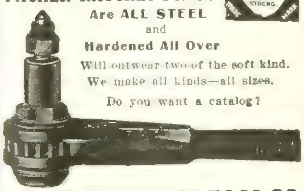

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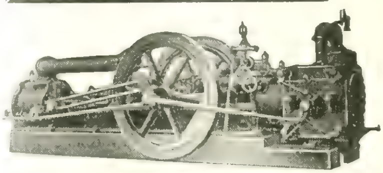

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SOUTH NORWALK, CONN.
Makers of Air and Gas Compressors
For All Purposes
Send for Catalog

Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVIII. 114 Liberty Street, New York, July, 1915. No. 7

High Bridge Across the Pecos River, Texas, Southern Pacific Railway

The prevailing opinion not only among the general public, but among railway men also, is that the most remarkable bridges and viaducts and feats of unusual railway engineering construction generally, occur in the mountainous regions, particularly in the Northwest. Those grandeur or more picturesque surroundings.

The Pecos bridge, on the Southern Pacific, is one of those rarities. It was built on the occasion of the re-alignment of the road between Thumla and Helmet in Texas, so as to save over twelve miles this location, all things considered, being very largely in its favor. The point of crossing ultimately selected called for a structure 2,180 feet in length, with the rails 321 feet above the level of the river.

The viaduct follows the usual American design, comprising masonry piers,

PECOS BRIDGE, SOUTHERN PACIFIC [illegible]

who have had opportunities to traverse some of the Southern routes are surprised at the stupendous engineering works that meet the eye here and there, and are seldom or ever heard of, not because they are out of the beaten highways of traffic, but because they are not so loudly placarded as other structures that may be set [illegible] wilder

in winding curves, and to avoid the danger and expense of working a line through the Rio Grande canyons. But in the revision it was faced with one serious obstacle—the Pecos river. This waterway had carved a course through a rift some 300 to 400 feet in depth. The company decided, however, to incur the bridging of the Pecos, the advantages of

supporting steel trestle towers, the principal of which is 269½ feet in height. The viaduct is divided into forty-eight spans, the pier spans being 35 feet and the clear spans 65 feet in length. The river itself is bridged by a cantilever 185 feet in length. At the rail level the viaduct is 20 feet in width, so that there is not only space for the track, but a side walk on

either side for the use of the railway employees. At the time of its original construction, in 1892, the bridge was designed for the heaviest kind of train service, but the increase in the size and weight of locomotives and rolling stock rendered the viaduct somewhat light for the constantly increasing weight of traffic, the result being that it has undergone recent reconstruction, this work taking place without disturbing the train service.

Other features less spectacular, but no less important, meet the discerning eye all along the great Southern roadway. We recall last century experiences at many of the division points where the means for running repairs were of the most primitive kind, and where there are now machine shops and roundhouses that seem to be made of solid granite, so perfect has the concrete construction become. Every modern appliance is at hand in these finely constructed buildings. The same general stability is seen in the smaller bridges and culverts along the substantial roadway. The wooden structures seem to be entirely superseded by steel and concrete, and as for the rolling stock, we doubt if anything in the world surpasses the equipment of the Southern Pacific, especially those palatial trains that seem to be so popular with the increasing throngs that find their way to the Panama-Pacific Exposition.

Railways in Costa Rica.

[illegible] Northern Railway Co. owns and manages all lines of railway on the Atlantic coast of Costa Rica and on the Pa- [illegible] San Jose and Mejuela, altogether making over 400 miles [illegible] locomotives, 40 passenger cars, about 500 freight cars, several steam shovels, wrecking cars, car shops, and all other machinery and equipment of a modern railway. Its principal office in the country is at San [illegible] San Jose.

The Delaware and Hudson Company in Canada.

[illegible] two railways in Canada the Quebec, Montreal and Southern, extending from Noyan Jct., to Belleville, 81 miles, from a junction with the G. T. R. at St. Lambert to Fortierville, 109.69 miles, and from St. Constant Jct. to Napierville Jct., 1.40 miles, a total of 192.09 miles; and the Napierville Jct., from St. Constant Jct. to Rouse's Point, Que., 27.06 miles. At the latter point connection is made [illegible] main line, which extends south to Wilkes-Barre, Pa. The total mileage of railways owned and operated by the company is [illegible]

Railroads in the South.

Railroad companies in the South have shown a warm interest in the movement for good roads. The railroads are working for improved transportation and communication other than by steel rails. Railroad officials point out that the railroads are just as anxious for better highways as anybody else, realizing that better roads will help develop the country and make increased business for the carriers. As never before, perhaps, the significance of Fairfax Harrison, president of the Southern Railway, being also head of the American Highway Association, has been impressed on the people of the South.

Russian Railway Extension.

The administration of railways in Russia has made the following appropriations in the estimate of expenses for 1915: The sum of $13,056,589 has been appropriated for the purchase of 90 passenger engines and 390 freight engines, with equipment. The amount of $6,366,237 is assigned for the purchase of 8,350 freight cars, and $2,994,308 has been appropriated for the purchase of 505 passenger cars. In connection with the proposed direct international railway communication, the Russian tariff committee proposes to construct direct lines connecting Archangel with Vologda, Petrograd, Moscow, Kief, Warsaw, Saratof, Kharkof, Odessa, Ekaterinoslav, Omsk, Riga, and Reval, and through Archangel connecting with the ports of New York, Halifax, Liverpool, and [illegible]

International Engineering Congress, 1915.

[illegible] engineering construction will receive special attention in the proceedings and discussions of the International Engineering Congress to be held in San Francisco, September 20-25 next. The field will be treated under 18 or more topics, covering: Timber resources, perservative methods; brick and clay products in general; life of concrete structures; aggregates for concrete; waterproofing; volume changes in concrete; world's supply of iron; life of iron and steel structures; special steels; status of copper and world's supply; alloys; aluminum; testing of metals, of full [illegible] prepared by authors representing five different countries. The list of authors includes many of the most eminent names in this field of engineering work throughout the world. These papers, together with discussions contributed by leading American and foreign engineers, will be published as volume 5 of the transactions.

Railways in New Zealand.

All the steam railways in New Zealand are owned and operated by the government, and with very good results. There were 2,945 miles in operation on March 31, 1915, which earned $1,459,801 during March this year, at an operating expense of $1,235,911 for the same period. New lines are under construction and others are contemplated, and railway development is one of the important items of internal improvements now before the government. In this, American railway material men should have an increasing interest, since American railway supplies are gaining favor, 10 locomotives just having arrived about the end of May. The contract for the manufacture of the engines was completed within the stipulated time by the Baldwin Locomotive Works, but were delayed in obtaining space and by the protracted voyage.

Railroads Divorced from Water Transportation.

Nearly all railroad men have been surprised at a decision of the Interstate Commerce Commission which makes it unlawful for any railroad company to hold financial interest in any steamship line. The decision is the most momentous ever applied to railroad interests, and is destined to have a far-reaching effect. The decision makes it unlawful for any railroad to retain any interest in a water line except in such instances as the Interstate Commerce Commission shall decide do not compete for carrying traffic. Nine important railroad systems are affected by this decision, and it is likely to exert a most pernicious influence upon the property involved. It magnifies in no small degree the importance of the Interstate Commerce Commission.

Railroad Device of Satan.

In 1828 the school [illegible] Lancaster, Ohio, refused to permit the schoolhouse to be used for the discussion of the question as to whether railroads were practical or not, and the matter was recently called to mind by an old document that reads in part as follows:

"You are welcome to use the schoolhouse to debate all proper questions in, but such things as railroads and telegraphs are impossibilities and rank infidelity. There is nothing in the word of God about them. If God has designed that his intelligent creatures should travel at the frightful speed of fifteen miles an hour, by steam, he would have clearly foretold through his holy prophets. It is a device of Satan to lead immortal souls down to hell."

The Panama-Pacific International Exposition

By ANGUS SINCLAIR

Were we to estimate the importance of the Panama-Pacific International Exposition now in display in San Francisco, California, by the area of ground covered by the buildings, it would compare indifferently with several exhibitions that have been witnessed in past years in various parts of the world, at Chicago, at St. Louis, in London and in Paris; but the Panama-Pacific exposition has peculiarities and structures of its own that no other exposition ever displayed. Erected on a stretch of ground covering 635 acres, on the border of the San Francisco Bay, reaching inland from the famous Golden Gate, the exposition looks out upon magnificent scenery seldom equalled by scenery in any other part of the world. The area is two and a half miles in length by an average of one-half mile in width.

Comparing this with many other exhibitions that I have seen, its most striking features are the highly artistic character of its buildings and the attractive use made of vegetable products, trees, bushes and flowers of the most amazing variety. For a person having an appreciative eye for the beauties of nature, I can imagine no greater eye feast than rambling slowly about the ornate spaces surrounding the exposition buildings.

Through the courtesy of an eminent railway official my name was presented to the management of the exposition, as a person properly qualified to act on a jury selected to consider the merits of appliances used in the transportation of passengers and freight. Accordingly a letter was received from Mr. Charles C. Moore, president of the Panama-Pacific Exposition, part of which read: "Reposing special trust and confidence in your ability and integrity, I have much pleasure in appointing you a member of the International Jury of Award of the Panama-Pacific International Exposition, more expressly with reference to Group 103 in the Department of Transportation."

This appointment was readily accepted, and on May 3 I commenced, with thirteen others, the duty of examining the transportation exhibits that are under the charge of Mr. Blythe H. Henderson, Chief of Transportation. Our daily procedure was to meet each morning in an office assigned to our use, and discuss together the merits of the various exhibits we had examined on the previous day and adjudge awards. Sometimes there was considerable diversity of opinion concerning the merits of certain devices, but by reasoning together we always reached a harmonious agreement. The proprietors of articles that received consideration from the Transportation Judges may rest assured that their property was judged on its merits without favor or prejudice.

The line of devices that are most likely to interest our readers belong to rail transportation, and I shall confine my remarks to that line of modern endeavor. I say modern endeavor, although as a matter of fact, devising means of improving the methods of moving people, animals and goods from one place to another engaged the energy, industry and ingenuity of human beings ever since man rose higher than a mere beast of burden.

Before going into details about modern transportation appliances, I should like the readers of these pages to reflect on the advances made in transportation during the lives of people still in possession of their mental faculties. The writer can look back with discriminating memory over the inventions brought out during half a century for improving methods of transportation, and the impression given is that nothing beyond elements preceded that range of memory. Today we have highly developed methods of transportation on land and in the air, on water and under water, with appropriate facilities to perform the work. Details of these facilities are legion.

At the exhibitions I have attended in past years, where railway appliances were in evidence, motive power held a conspicuous place, but the Panama-Pacific display fails to give the locomotive a prominent place. There are five Baldwin locomotives, four from the American Locomotive shops, three from the Southern Pacific Company rolling stock and one from the McCloud River Railway, a lumber concern that uses the engine for logging purposes. While the locomotive exhibits are small, the display of motor power appliances is remarkably good, some of the individual exhibitions, such as the Flannery Bolt Company, the National Malleable Castings Company and the Westinghouse companies having excelled themselves in making attractive displays.

Some of the railroad companies have displayed wonderful enterprise and liberality in the installation of exhibits, particularly the Pennsylvania Railroad and the Southern Pacific Company. The Pennsylvania Railroad System exhibit, which is in charge of Mr. H. T. Wilkins, has proved one of the most attractive parts of the exposition and Mr. Wilkins has displayed masterly power in explaining the details. What has proved an excellent educational part of the exhibit is a motion picture theatre constructed by two standard steel passenger cars cut in two longitudinally and forming a single apartment where the people sit gazing upon the scenes displayed with rapt attention. There is a relief map showing the whole of the regions traversed by the great Pennsylvania System, and it exerts a very important educational purpose.

Among the details of this splendid exhibit are views of the Pennsylvania system in relief by the largest relief map ever constructed. This splendid map is forty-two feet in length by twenty-six feet wide, and showns in detail the stretch of the United States and Canada from the Atlantic Ocean to the prairies beyond the Mississippi river and from Chesapeake Bay and Virginia to the plateaus of Ontario and Quebec.

An illustrated circular informs us that the Pennsylvania system, with its 11,729.92 miles of length, and its 26,200 miles of track, its 250,000 employees, 7,561 locomotives, 6,884 passenger cars, 281,590 freight cars and 68 steamers and ferry boats, directly serves fifteen of the forty-eight States of the Union and the District of Columbia, whose combined population is 43,227,840 or 52 per cent. of the entire population of the United States.

The Southern Pacific Company has a splendid exhibit of different kinds of railway rolling stock besides a moving picture display which attracted much attention and exercised an excellent educational effect upon the beholders. The Canadian Pacific Railway Company has a similar moving picture display, an educational method that was adopted by several other exhibitors.

I have already mentioned the Flannery Bolt Company, of Pittsburgh, which displayed samples of Tate flexible staybolts for locomotive fireboxes; adjustable Tate flexible crown stays; standard water space stays, tools for applying flexible staybolts and a variety of other devices used in the construction of locomotive fireboxes.

The Gold Car Heating & Lighting Co., New York, has a most attractive display of car heating and lighting appliances that embrace steam, vapor, combination pressure and vapor, hot water and electric systems; thermostat control for same; cyclone and window ventilation. As a visitor lingers about the exhibit the wonder grows that so many curious devices could be used in regulationg the heat of a car and how well it is done.

Car couplers and their attachments are remarkably represented in the display made by the Cleveland Malleable Castings Co., supplemented by a variety of familiar attachments. Among the couplers are the Sharon, Iowa, Climax and Latrobe. Then there are cast steel coupler yokes, engine coupler pockets with supporting shelf, uncoupling apparatus, journal boxes, brake beam fulcrums and nearly all the small

[illegible] generally.

[illegible] Westinghouse exhibits embrace the air brake company's highly perfected appliances, Westinghouse Electric & Manufacturing Co., Westinghouse Traction Brake Company's devices. A part [illegible] and attracted much attention was an electric turntable carrying a Pennsylvania locomotive kept moving round all the time. Besides these there is electric equipment of various kinds for both locomotives and cars, a pressed steel frame motor, specifications, publications, drawings relative to electric railways, a wheel lathe motor and various blue prints.

The jury for Group 103 convened on May 3 and elected Mr. H. J. Small chairman and Mr. L. E. Warford secretary. A picture of the jury with the names annexed is here shown. The jury visited all the exhibits and examined them carefully and then discussed the merits of each.

American Brake Shoe & Foundry Company.

American Arch Company.

Chicago Car Heating Company.

Canadian Pacific Railway Company.

Denver & Rio Grande Railroad Company.

Flannery Bolt Company.

Gold Car Heating & Lighting Company.

Grand Trunk Railway Company.

Galena Signal Oil Company.

Griffin Wheel Company.

Great Northern Railway Company.

Locomotive Stoker Company.

Manganese Steel Rail Company.

National Brake & Electric Company.

The Railroad Supply Company.

St. Louis Car Company.

Standard Steel Works.

Safety Car Heating & Lighting Company.

Taylor Wharton Iron & Steel Company.

Union Switch & Signal Company.

Austin Western Machinery Company.

Detroit Lubricator Company.

W. J. Hickey.

Hwa Nan-Kwei, China.

Hupp Automatic Mail System.

Hewitt Rubber Company.

Independent Pneumatic Tool Company.

General Brake Shoe Supply Company.

H. W. Johns-Manville Company.

McCord & Company.

Ohio Locomotive Crane Company.

Pittsburgh Steel Foundry Company.

Parkesburg Iron Company.

Pennsylvania Steel Casting & Machine Company.

T. H. Symington Company.

St. Louis Steel Foundry Company.

Taylor Portable Steel Derrick Company.

United States Metallic Packing Company.

HONORABLE MENTION

J. G. Brill Company.

Hobart-Allfree Company.

PANAMA-PACIFIC EXPOSITION JURY—READING FROM LEFT TO RIGHT THE COMMITTEE OF AWARDS ARE:

[illegible]

[illegible]

The list of awards made by the jury [illegible] follows:

GRAND PRIZE

[illegible]

The Pennsylvania Railroad System.

The United States Steel Corporation.

Baldwin Locomotive Works.

Westinghouse Air Brake Company.

United States Post Office Department.

MEDAL OF HONOR

American Locomotive Company.

Cambria Steel Company.

[illegible] Republic of China.

National Malleable Castings Company.

New York Air Brake Company.

[illegible]

[illegible]

The Locomotive Superheater Company.

Westinghouse Traction [illegible] Company.

[illegible]

[illegible]

[illegible]

E. & T. Fairbanks & [illegible] bury, Vt.

SILVER MEDAL

Adams & Westlake Company.

American Steel Foundries.

Ashcroft Manufacturing Company.

Han-Yet-Pang Iron & Steel Company, Han-Yong, China.

Chicago Railway Equipment Company.

California Dispatch Line.

Franklin Railway Supply Company.

German-American Car Company.

Ohio Injector Company, Chicago.

Hale & Kilburn Company.

International Harvester Company.

W. H. Miner Company.

McCloud River Railroad Company.

Nathan Manufacturing Company.

Pyle-National Electric Head-light Company.

Union Draft Gear Company.

Orenstein-Arthur Koppel Company.

[illegible]

E. C. Atkins & Company, Inc.

Ajax Metal Company.

Philip Carey Company.

Chambers Valve Company.

Copper River & Northwestern Railway Company.

McLeod Company.

Sargent Company.

The Committee in its final session, confirmed the awards made in the above list.

The following resolution was unanimously adopted:

RESOLVED: That the Jury of Group 103 desires to express its high appreciation of the work of Mr. Blythe H. Henderson, Chief of Transportation. It also expresses its thanks to Mr. Henderson and his assistant, Mr. L. E. Warford, for their unfailing courtesy and assistance, and beg to suggest that they receive suitable commemorative medals and diplomas, if such suggestion be proper as coming [illegible].

The time occupied by the committee in their deliberations extended to nearly three weeks, and it is no idle boast to state that every detail of the complex work submitted to them was carefully examined and reported upon at the regular meetings of the committee and while all of the members were not familiar with all of the devices submitted, it was surprising how large a number of them showed a knowledge of the subjects.

An Introduction to the Study of Air Brakes

By WALTER V. TURNER, Assistant Manager Westinghouse Air Brake Company

The usual method of commencing the study of the air brake as a whole, or of any of the devices which it comprises, is to learn first the location and relation of the different chambers and passageways of the individual devices involved and the various inter-connections which are made according to the different positions of the moving parts of the various mechanisms. All of this is well enough in its proper place, but it is a study of effect rather than cause—of results rather than principles; and the writer is more concerned with the principles and laws underlying the operation of the automatic air brake being understood than that the construction or detailed operation of any particular apparatus be committed to memory. If the laws and principles governing the operation of pneumatic brake mechanisms are mastered at the outset, so that they are thoroughly understood, they can then be intelligently applied to any device or combination of devices which may have to be dealt with and the purposes, functions and merits of the apparatus can be clearly judged.

If the student will sub-divide his consideration of the air brake into the following, viz.: What it is. (The mechanical parts of the apparatus.) What it does. (Controls the speed of trains.) How it does it. (By the movement of its parts and development of friction.) Why it does it. (Physical laws governing its operation.) How to do it and the results. (Manipulation.) (Good, bad or indifferent, according to its condition, and the knowledge and judgment used in its manipulation), he will find his task much more easily and quickly accomplished.

The air brake consists of a self-contained or closed system of receptacles and moving parts, and when in working order is charged with compressed air. Its operation is caused by opening and closing the main circuit of the system to the atmosphere, which produces a difference and equalization of the pressures in the system, that is, a difference in pressure causes the brake to apply or release and an equalization or balance of pressure causes it to remain released or to remain applied, and it makes no difference how these variations are brought about, whether by human agency or any other cause, the effect is the same, and obviously if the brake is to be automatic in its action (operated by the opening of the system) this must be the case.

The fundamental automatic air brake system forming the elemental unit consists of: First, a compressor; 2nd, a brake pipe with closed ends; 3rd, a triple valve; 4th, a reservoir; 5th, a brake cylinder; 6th, mechanical connection between brake cylinder and brake shoe, and 7th, a brake shoe; the operating power being compressed air. To serve practical purposes, however, it is necessary on at least one vehicle to add a storage reservoir and an operating valve and on all vehicles a system of compound levers.

From the compressor is a pipe (called the brake pipe) leading to a reservoir (called an auxiliary reservoir); in the pipe leading to the reservoir is a valve device (called a triple valve), having a movable partition or piston and a slide valve which controls ports to and from the reservoir and brake cylinder, and to the atmosphere. The piston divides, except to a limited extent, the air of the brake pipe from the air of the reservoir, thus permitting the pressure relation of these volumes to be changed. The reservoir contains the air that, when it is desired, passes to the brake cylinder forcing out its piston, thus moving the system of levers and exerting the power that applies the brake; the whole process of applying and releasing the brake being brought about by reducing and increasing the brake pipe pressure, thus causing the movements of the piston and slide valve above referred to. In the pipe between the compressor and the valve device is located a valve (called a brake valve) which is operated manually, and, when moved to one position (called release position) permits the air from the compressor to flow to the brake pipe and force the piston of the triple valve to release position, charging the reservoir. When moved to another position (called application position), this valve permits of the brake pipe being opened to the atmosphere, thereby reducing the pressure on the brake pipe side of the piston of the triple valve, so that the then higher pressure in the reservoir can push the piston, which can move a short distance before it moves the slide valve, toward the brake pipe, closing the limited communication between brake pipe and reservoir. Then, having come in contact with the slide valve, it drags it along until the outlet from the brake cylinder to the atmosphere is closed and a passage opened from the reservoir to the brake cylinder. As the air will now reduce equally, and at the same rate, on each side of the piston, until the reduction in the brake pipe ceases or until the air in the reservoir and cylinder reach equal pressures, the piston and slide valve will remain stationary. In the event of the reduction in the brake pipe being made short of the equalizing point of the reservoir and the brake cylinder (by using the lap position hereinafter mentioned), the piston will return in the direction of release and by means of a small valve (called a graduating valve) which is attached to the piston and moves with it, closes the port from the reservoir to the brake cylinder, thus stopping the flow of air. This movement takes place because when the outlet from the brake pipe to the atmosphere was closed the still open ports from the reservoir to the brake cylinder permitted the reservoir pressure to fall slightly below that of the brake pipe, the higher pressure then moving the piston toward the lower pressure. The reason the piston does not make its full traverse toward the release position is because the friction of the slide valve makes it a resistance block, which the slight difference of the pressure required to move the piston only cannot overcome. Therefore, when the piston comes in contact with the slide valve, it is stopped and remains in that position until the balance of pressure is destroyed when it will move again, and of course in the direction of the lowest pressure; thus it will be seen that either a full or partial application of the brakes can be made.

The brake valve has still another position (called lap position) and when the valve is moved to this position all ports are closed, that is, there is no communication from the compressor to the brake pipe nor from the brake pipe to the atmosphere; this position of the brake valve is to be used only when the brakes have been applied and it is desired to hold them applied, for, obviously, the increase of pressure necessary to release the brake or the further decrease in brake pipe pressure necessary to further apply the brake will not take place at this point as long as the valve is in this position.

The brake is released by increasing the pressure in the brake pipe above that of the reservoir, by admitting more air to it through the brake valve, thus forcing the triple valve and slide valve to release piston position which opens a passage from the brake cylinder to the atmosphere; or, if the car is detached from the source of pressure, by exhausting the air from the auxiliary reservoir and brake cylinder, means being provided for this purpose.

All the things mentioned in the foregoing must be present in an automatic air brake system, and it is not complete or operative if any one be absent; in practice, however, other parts or accessories are added for many reasons that will be apparent as the reader becomes familiar with the elements of the brake system and the many conditions to be met, but which it is not proper to incorporate here, as this article is intended only to deal with the essentials and not the modifiers of the system.

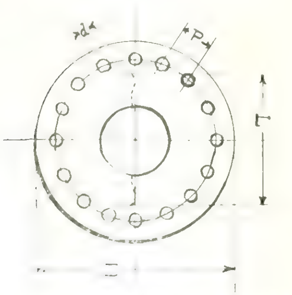
Applying An Efficient Boiler Patch

Patches Should Be Thicker Than the Original Sheet
A Double Row of Rivets Necessary

By HUGH G. BOUTELL, Washington, D. C.

Since the law requiring the reporting of all patches on locomotive boilers to the Interstate Commerce Commission went into effect, much more attention has been given to this end of boiler repair work than was formerly the case. It was not very long ago when "any old piece of iron and any arrangement of rivets" was good enough for a boiler patch, and the surprising thing is that these patches really did hold on in some way, for comparatively few boiler explosions can actually be traced to the failure of a patch. This often reminds me of the law requiring individual drinking cups in cars and stations. If the old tin cup was so unsanitary it is a wonder that any of us, who lived in the days before the germ, are alive today. However, there is a big difference between the two cases, for the number of deaths caused by using the tin cup is harder to figure out than the efficiency of a patch, which, when once clearly understood is a comparatively easy thing to do, [illegible] there is really no excuse for an inefficient patch on a boiler.

I will illustrate what I mean by the simple case of a patch at the check valve hole of a locomotive boiler. Usually in this case, radial cracks most often along the length of the plate, start out from the hole and a piece of metal is applied to the outside of the plate to prevent further spreading of these defects. One [illegible] that used to be applied



[illegible] OVER [illegible]

[illegible] boiler [illegible] Fig. 1 [illegible] which [illegible] between [illegible] rivets [illegible] than that of the original sheet, so that the term tearing usually means tearing the boiler shell. In any case the efficiency in tearing will be given by the formula:

$$e_t = \frac{P - d}{P}$$

Where, e_t equals the efficiency, P, the pitch of the rivets, and d, the diameter of the rivet holes.

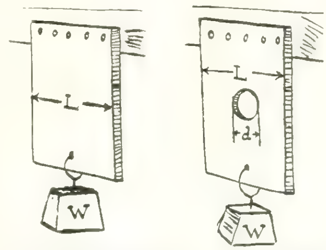


FIG. [illegible] THE EFFICIENCY OF PLATES IN TEARING.

The truth of the above formula will be apparent if we remember that the efficiency in this case is merely the ratio between a given length, P, of the plate and a length P — d of the same plate. Look at Fig. 2, for instance. Here we have two pieces of cardboard hung from a beam with equal weights, W, suspended from their lower ends. The first piece is solid all the way across, while the second has a hole of diameter d cut in it. The thickness being the same, it is evident that the portion resisting tearing in the two pieces is a section of uniform thickness and of lengths L and L — d, respectively. The efficiency is therefore expressed by the formula

$$e = \frac{L - d}{L}$$

Substitute P for L and we have our first equation.

Now the other way our patch may fail is by shearing the rivets. The length of the defective portion of the plate is L, and the only rivets which resist the tendency of the plate to pull apart are those opposite the defect; five on each side in this case. The reason that only those rivets opposite the defect are under stress is that none of the others can be put under stress unless the first ones give way. It is therefore evident that the greater the number of rivets opposite the defect the stronger will be the patch in shearing. At first sight one might say "increase the number of rivets and you'll have an efficient patch." On the other hand, the more rivet holes we drill out along any one line in the patch the weaker will be that section in tearing. There are just that many more d's to subtract from P. That is why it would do no good to add any more rivets around the outside of the patch in Fig. 1.

But suppose we make a patch like that shown in Fig. 3. Here the defect is of the same length as in Fig. 1, and the values of P and d are also the same. But in this case the patch is laid out so that there are two rows of rivets making an angle to the horizontal line of the plate. Such a patch will be much more efficient than the one shown in Fig. 1 in both tearing and shearing.

In tearing, the force tending to pull the plate apart does not act at right angles to the line of rivets. The component of this force is what acts, and the greater the angle of the rivets the less this force will be. It is not my intention to enter into the mathematics of boiler patches and seams, but it will be sufficient to say that the formula for tearing in this case becomes:

$$e_t = \frac{P - d}{P \cos^2 \theta}$$

Where θ is the angle formed by the rivet row with the horizontal line. The

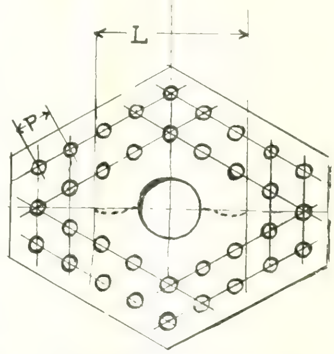


FIG. [illegible] AN EFFICIENT PATCH

cosine will always have a value less than 1, thus the cosine squared will be still smaller, and the efficiency will be correspondingly increased. As the different values of the cosine can be easily obtained from a table of trigonometric functions, no difficulty ought to arise in figuring out the efficiency of such a patch.

Now look at the number of rivets we have opposite the defect. There are 10

rivets on each side, as against 5 in Fig. 1, and this without weakening, but rather strengthening the patch in tearing.

These patches, which follow the general design of the "diamond seam" once in quite general use for the longitudinal seams of locomotive boilers, are probably as efficient as any that can be applied, usually having a higher efficiency than the seams of the boiler itself. Indeed by multiplying the rows of rivets it is possible to get more metal opposite the defect than there would have been in the original plate, and the efficiency in shearing will then be greater than 100 per cent. If we examine the formula for the efficiency of the patch to failure by shearing this will be perfectly clear. The formula may be written:

$$e_s = \frac{N \cdot S_r}{L \cdot S_p}$$

Where e_s equals the efficiency of the joint, N equals the number of rivets on one side of the defect, S_r equals the shearing strength of one rivet, L equals the total length of the defect and S_p equals the tearing strength of the plate. This formula holds for any kind of patch and any arrangement of rivets, and it is obvious that if the numerator comes out greater than the denominator the efficiency will be over 100 per cent.

A patch ought to be "balanced," that is, have very nearly the same efficiency in both tearing and shearing. "A chain is no stronger than its weakest link," and if a patch is but 80 per cent. efficient in tearing, there is no use in an efficiency of 95 per cent. in shear.

The above is not intended to be a treatise on patches. It merely shows what can be accomplished by using a carefully thought out arrangement of rivets, and while such patches may be a trifle more work to lay out and put on, this is but a small matter when compared to the tremendous increase in efficiency. At least one road has already adopted a system of standard patches, based on the above scheme, using blue prints showing the style of patch to be applied to every kind of defect, and I understand that the shops have carried out the work with no apparent difficulty. It is, without doubt, a "live" subject, and one in which all roads are taking considerable interest.

Manipulation of Journal Box Packing

By A. L. GREYBURN, M. E., Canadian Northern Railway

We were much interested in the excellent articles on Lubrication by Mr. F. P. Roesch, that appeared in recent numbers of RAILWAY AND LOCOMOTIVE ENGINEERING, and it occurred to me that in the same connection a few details of the methods of journal box packing in vogue on the Canadian Northern would be of interest to your readers who are interested in oiling methods. To begin at the beginning, the dry waste should have threads separated to remove all lumps and hard spots before being packed in the saturating tank, where it should be left submerged in oil for a period of not less than forty-eight hours, after which time it can be placed in the upper or drip tank until required for use.

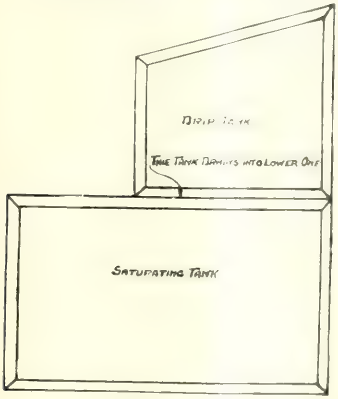


FIG. 1.

Eighty pounds of waste [illegible] imperial gallons of oil will insure a thorough saturation of the waste. After the required period of saturation forty gallons of the oil should be drawn off, leaving the ingredients in the following proportion: three gallons of oil to seven pounds of waste.

If the waste after the stated period of saturation is placed directly in the upper or drip tank, Fig. 1, it will automatically form the mixture suggested, as this is practically the greatest amount of oil that may actually be retained by the waste under normal conditions. Where old packing or reclaimed waste is used, two hundred pounds of old waste with forty pounds of new waste saturated with fifty-eight and a half gallons of oil, and allow the mixture to stand twenty-four hours, after which forty gallons of oil may be drawn off, leaving the reclaim to consist of eighteen and a half gallons of oil to two hundred and forty pounds of waste. This packing is equal to new.

Fig. 2 shows the most desirable method of applying the rear wall of packing. This should be twisted and wrung fairly dry in order to form a reserve sponge for any excess oil, and prevent the oil from being wasted on the wheels and right of way. It also forms a partial dust guard and must therefore be placed so as to completely fill the rear of the box and extend well up against the surface of the journal. The sponge packing should extend as shown, from the rear packing wall to the outer point of the journal fillet. The packing should be firmly placed under the journal to prevent the same from settling away, but it should not extend above the center line of the journal. A small quantity of waste should be placed in front of the collar, as shown, up to a point slightly less than one inch above the base of the journal. The formation of this front sponge should be entirely independent of the center of journal sponge, and should be well saturated with oil. No loose pieces of waste should be allowed to hang out from the front of the box at any point.

In regard to packing engine truck cellars, the packing should be separated [illegible] five walls of thin firm sponges, the two outer walls being to exclude dirt and dust, and the intermediate layers providing a supporting medium for the loose oil sponges. This system has been found to successfully prevent the packing from settling away from the journal. The packing should be placed lengthwise in the corners of the cellar, upon which are laid the sponges and parting walls already described.

Before packing car boxes in freight and passenger service, as well as tender truck boxes, it should always be observed that boxes are thoroughly cleaned out before repacking. Boxes should be repacked in all cases where excessive heating has occurred. The bearing surface of brasses and journals should be lubricated before [illegible]

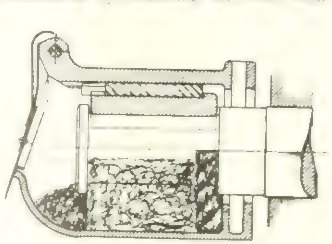


FIG. 2

waste on the surface, and the oil should be spread over the surfaces with the fingers. Waste should not be used in spreading oil over a journal bearing. In examining the packing it should be loosened up and note that a fresh surface of waste is always in contact with the journal, avoiding in all cases a hardened and glazed condition caused from deposit of metal due to wear of brass and [illegible] remained too long in one position.

If these rules are observed there will be little or no trouble with boxes.

Mountain Type Locomotives for the Seaboard Air Line

Large Increase in Tractive Power and Considerable Saving in Fuel Consumption

[illegible] have recently been [illegible] to the Seaboard Air Line by the American Locomotive Company. These mountain type locomotives were placed in service between Richmond, Va., and Columbia, S. C., supplanting an equal number of Pacific type superheater locomotives having 23 x 28-inch cylinders, 72-inch drivers, 195 pounds boiler pressure, total weight of engine 223,000 pounds, and 34,200 pounds tractive power.

The new mountain type locomotives have a total weight, engine and tender, of 499,000 pounds, and a tractive power of 47,800 pounds. The Pacifics supplanted have a total weight, engine and tender, of 397,300 pounds, and a tractive power of 34,200 pounds. With an increase in weight of 25.8 per cent., an increase of 39.8 per cent. in tractive power, combined with a more efficient boiler, was obtained. According to the American Locomotive Company's method of calculating boiler capacity, the Pacifics have an 86 per cent. boiler, while the mountain type has a 98 per cent. boiler.

All-steel through passenger trains con- [illegible] by these mountain type locomotives, the regular trains being 10 cars. The locomotives are assigned to runs from Richmond to Raleigh, 160 miles, on which there are several ruling grades of 1.2 per [illegible] to Columbia, 207 miles, on which there are several ruling grades of 1.25 per cent., 3½ miles long. The necessity for the introduction of the mountain type was on account of the inability of the Pacific type to maintain schedule up grade with 10 or [illegible] the maximum speed limit of 50 M. P. H. The Pacific type locomotives, with 11 cars, would drop back to from 18 to 20 M. P. H. before reaching the top of the heaviest grades, while the mountain type will maintain a speed of from 35 to 40 M. P. H. with the same train. On some occasions they have handled 12 heavy steel cars, maintaining a speed of 35 M. P. H. up grades.

Fuel consumption of the mountain and Pacific type locomotives handling the same train show:

Mountain type.. 12 pounds per car mile.
Pacific type.... 13.5 pounds per car mile.

This is a saving in favor of the mountain type of 11 per cent.

The general dimensions and other details of these locomotives are as follows:

Track gauge—4 ft. 8½ ins.

Fuel—Bituminous coal.

Cylinders—[illegible], 27 ins. diameter, [illegible] ins. stroke.

Tractive power—Simple, 47,800.

Factor of adhesion—Simple, 4.4.

Wheel base—Driving, 18 ft.; rigid, 18 ft.; total, 38 ft., 11 ins.; total, engine and tender, 76 ft., 8½ ins.

Weight—In working order, 316,000 lbs.; on drivers, 210,500 lbs.; on trailers, 52,500 lbs.; on engine truck, 53,000 lbs.; engine and tender, 499,000 lbs.

Boiler—Type, Extension wagon top, conical conn.; O. D. first ring, 76½ ins.; working pressure, 190 lbs.

Firebox—Type, wide, length, 114⅛ ins.; [illegible] length of chamber, 44¾ ins.; thickness of crown, ⅜ in.; tube, ⅝ in.; sides, ⅜ in.; back, ⅜ in.; water space, front, 5½ ins.; sides, 5 ins.; back, 5 ins.; depth (top of grate to centre of lowest tube), 28¼ ins.

Crown staying—Radial.

Tubes—Material, seamless steel; number, 193; diameter, 2¼ ins.

Flues—Material, seamless steel; number, 34; diameter, 5½ ins.

Thickness tubes—No. 11 B. W. G.; flues, No. 9 B. W. G.

Tube—Length, 21 ft.; spacing, 13/16 ins.

Heating surface—Tubes and flues, 3,396 sq. ft.; firebox, 293 sq. ft.; arch tubes, 26 sq. ft.; total, 3,715 sq. ft.

Superheater surface—865 sq. ft.

Grate area—66.7 sq. ft.

Wheels—Driving, diameter outside tire, 69 ins.; center diam. 62 ins.; driving, material, main, cast steel; others cast steel; engine truck, diameter, 33 ins.; kind, rolled steel; trailing truck, diameter, 42 ins.; kind, cast steel; tender truck, diameter, 33 ins.; kind, rolled steel.

Axles—Driving journals, main, 11½ x 21 ins.; others, 10x12 ins.; engine truck journals, 7 x 12 ins.; trailing truck journals, 9 x 14 ins.; tender truck journals, 6 x 11 ins.

[illegible] TYPE LOCOMOTIVE FOR [illegible] RAILWAY
[illegible] American Locomotive Company, Builders.

Boxes—Driving, main, cast steel; others, cast steel.

Brake—Driver, American W. N. & B. C., Westinghouse E. T. No. 6; tender, Westinghouse E. T. No. 6; air signal, Westinghouse Sch. L., pump, 2-9½ ins., West reservoir 1-22½ x 108 ins., 1-22½ x 42 ins.

Engine truck—Woodard.

Trailing truck—Radial, Cole type.

Exhaust pipe—[illegible] ins., 6¼ ins.

Grate—Style, rocking.

Piston—rod diameter, 4¾ ins.; piston packing, U. S. Metl., King type.

Smoke stack diameter, 19 ins.; top above rail, 180½ ins.

Tender frame—Commonwealth cast steel.

Tank—Style, Vanderbilt; capacity, 9,000 gallons; capacity fuel, 17 tons.

Valves—Type, piston; travel, 7 ins.; steam lap, 1¼ ins.; ex. cl., 3/16 in.; setting, line and line in full gear forward, ⅜ in. lead full gear back.

Annual Convention of the American Railway Master Mechanics' Association

The forty-eighth annual convention of the American Railway Master Mechanics' Association was held in Atlantic City, N. J., beginning on Wednesday, June 9, and continued during the succeeding two days. The president, Mr. F. F. Gaines, superintendent of motive power, Central of Georgia Railway, presided and opened the proceeding with a very interesting and eloquent address. He dwelt on the need of one central organization in the mechanical department of railroads, which could be divided into such sections as might be found advisable. The necessity of having fixed standards in the way of methods and specifications for all classes of material, called for a supreme association which could pass upon the work of the minor associations or sections. Mr. Gaines also strongly favored the higher education of boiler inspectors, foremen, enginemen and firemen, and the providing of a more thorough examination for firemen before their promotion.

Mr. J. W. Taylor, secretary, read the minutes of the previous meeting and the annual reports, from which it appears that there are 979 active members, 47 honorary members and 19 associate members, making a total of 1,061. The treasurer's report showed a cash balance during the year of $1,213.28.

The reports of the various special and standing committees on the subjects assigned to them were ably discussed by the members and a mass of information was presented which will be published in detail in the volume of proceedings of the association. It may be stated briefly that the various reports showed that the committees had taken considerable pains to secure as much information as possible on the various subjects, and that the discussions, while they were of interest as adding to the volume of information, generally bore out the conclusions of the work of the committees. The following condensed reports of the work of the committees may be fairly said to represent the most prominent features of the most important reports.

[illegible]

A comprehensive presentation of specifications for steel axles for locomotive tenders, journal boxes, cast iron wheels, boiler and fire-box steel, locomotive forgings, cylinder castings, bushings and packing rings was made by the committee and also important details in regard to the inspection and testing of locomotive boilers. In regard to the setting of safety valves the committee recommended that safety valve shall be set to pop at pressures not exceeding 6 lb. above the working steam pressure. When setting safety valves, two steam gages shall be used, one of which must be so located that it will be in full view of the person engaged in setting such valves; and if the pressure indicated by the gages varies more than 3 lb. they shall be removed from the boiler, tested and corrected before the safety valves are set. Gages shall in all cases be tested immediately before the safety valves are set or any change made in the setting. When setting safety valves the water level in the boiler shall not be above the highest gage cock.

F. F. GAINES.
President, M. M. Association, 1914-15.

LOCOMOTIVE STOKERS.

The committee on this subject reported that while nothing novel had been presented during the past year, a great deal of very good work had been done along already established lines. Details had been refined. New parts had been added. Some parts had been dispensed with. Simplicity was being aimed at. At the present time there are 282 Crawford double-underfed stokers in operation on the Pennsylvania Lines north of Pittsburgh. In addition to these are 9 of the same type in operation on other roads, making a total of 291. A new pattern of this stoker is being constructed for test. It is the only underfed stoker in operation in America. The Street stoker has the largest number in service, totalling 531 and 24 on order. These stokers are in operation on 15 railroads on all types of locomotives, and are doing their work satisfactorily. Besides these there are 22 of the Standard type in operation, of which good reports are being made. Of the Hanna type there are 18, besides one each of the Gee, Ayers, and Kincaid types, all of the overfeed or scatter type. The committee are hopeful that a complete test on one of the University plants will be made, which would set at rest many opinions as to the relative consumption of fuel with different grades of coal. It is to be hoped that such a test will be made possible in the near future.

SMOKE PREVENTION.

The committee on Smoke Prevention reported that they had made no new tests of smoke-preventing apparatus on steam locomotives, but presented a brief description of the improved methods and results concerning the problem in the city of Chicago, where there are 54 smoke inspectors whose observations cover not only the railroads, but the entire city. The use of steam air jets, quick-action blowers, and other devices recommended at the convention in 1913, has confirmed the belief that locomotives equipped therewith may be kept comparatively free from smoke, provided the engine crews are instructed in the proper use of these devices and carry out such instructions at all times. The reduction in the percentage of density of railroad smoke during the past few years in Chicago, which is the largest railroad center in the world, has been such that according to official data the record was as follows: In 1910, 22.3 per cent. percentage of density. In 1912, 10.74 per cent. In 1913, 6.06 per cent., and in 1914, 7.41 per cent.

FUEL ECONOMY.

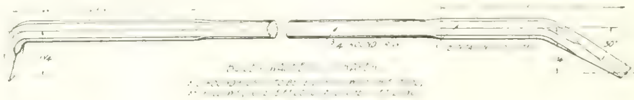
The committee on Fuel Economy, which is a standing committee, under the able chairmanship of Mr. William Schlafge, general mechanical superintendent of the Erie, submitted a comprehensive report covering all phases of the subject. The committee stated that greater attention is being given to the design of boilers, fire boxes, grates, ash pans and front ends, than ever before, as all of these parts are interdependent and should bear a definite relation for the best results, and are influenced by the nature of the fuel available. Tables showing the results of tests clearly demonstrated that the design of a locomotive boiler and fire box, together with the appurtenances, which will permit of the largest amount of evaporation from a given amount of combustible burned, has the maximum efficiency, and is, therefore, the best boiler, from the standpoint of fuel economy. This is the ideal for which all should strive, and which is being approached more nearly as time goes on. The advantages of increased heating sur-

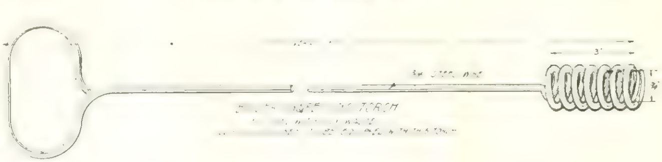
[illegible] and larger grate area was clearly pointed out in the report, and the importance of the design of exhaust nozzles to suit the various conditions was shown as a factor in fuel economy. A number of roads have experimented with special types of nozzles, and claim a considerable saving in fuel as a result. The subject presents a fertile field for future investigation, due to the continued changes in conditions. Regarding the amount of air opening in ash pans, the committee were of opinion that this should not be below 12 per cent. of the grate area for locomotives having 70 square feet of grate area, and this percentage should be increased with smaller grate areas. The superheater was commended as the most valuable mechanical aid ever applied to locomotives. By its use savings of 20 to 25 per cent. in coal and water are obtainable in actual service. The committee also strongly favored the use of a full throttle opening, with reverse lever control as far as service conditions will permit. A full throttle opening and a short cut-off being almost always preferable to a partial throttle opening and a longer cut-off. A valuable code of instructions to bring about the economical use of fuel is added.

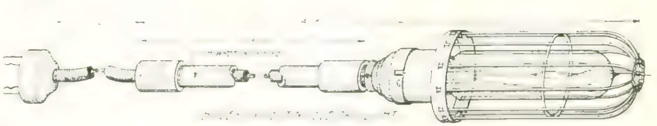
[illegible]

A uniform method for determining [illegible] was deemed [illegible] the most pressing and important phase of the locomotive boiler question. An investigation of the methods in vogue elicited replies from 44 roads, and from these and the methods of various other authorities, such as the locomotive builders and American Society of Mechanical Engineers, were also carefully investigated [illegible] presented, from which the following, in regard to [illegible] as a sample: When boiler shells are cut to apply steam domes or manholes, the amount of metal in flange and liner shall [illegible]. When separate flange is used at base of dome, the entire net area of same shall be assumed as reinforcement. Where dome sheet is flanged direct to shell of boilers, a vertical distance of 2 in. from base of flange shall be assumed as reinforcement, using net area after rivet holes are deducted and using 28,500 lb. tensile strength per square inch as the ultimate [illegible] tically.

About thirty pages of printed matter was furnished in the report of the committee on Boiler Washing, giving information from all the principal railroads in the country from which it may be gathered [illegible] miles between wash-outs, 11,283 engines made less than 1,000 miles; 8,312 engines made over 1,000 miles, and less than 1,500, and 20,472 engines made over 1,500 miles. The passenger locomotives make 30 per cent. greater mileage between wash-outs than freight engines. The average number of wash-out plugs in modern locomotives is 32. Washing out with hot water costs 35 per cent. less than with cold water. Roads using water-softening plants report over 100 per cent. in mileage. All locomotives in service must have boilers washed out at least once every thirty days or less, if conditions require. Wash-out nozzles should be so constructed as to throw a solid stream out of a ⅝-inch hole with 100-pound pressure. The cost of washing out with cold water costs about $4.50, and with hot water about $3. The incrusting matter in boiler waters consists almost entirely of carbonates of lime and magnesia and sulphates of lime [illegible] The [illegible] with [illegible] and the [illegible] The accompanying illustration shows the design of some of the accessories used in boiler washing on the Santa Fe.







[illegible]

The [illegible] the meeting of the American Railway Master Mechanics' Association and the Master Car Builders' Association held jointly [illegible] the committee of which [illegible] Vov, assistant superintendent of motive power of the Chicago, Milwaukee & St. Paul, was chairman. They presented a tentative programme showing that the subjects discussed were almost common and of mutual interest to both associations. The logic of the programme was convincing if the desire to get together is genuine.

[illegible]

The [illegible] tion in continuing the able committee on this important subject, and of which Mr. D. F. Crawford, general superintendent of motive power, Pennsylvania Lines, is chairman, is shown by the thorough manner in which the committee continue their investigations. Legislative enactments are thick as fireflies, so much so that the committee does not believe that there has been any serious attempt made by the railroads to produce a headlight to meet the Master Mechanics' requirements. A number of headlights, however, have been developed recently that meet the requirements, and while the subject promises to be discussed for many years to come before any particular conclusion will be arrived at, some real progress is being made year by year. In regard to incandescent lamps, the committee recommended that they should be approximately 50 mean horizontal candle-power, which would give sufficient light to meet the recommended maximum requirement of 3000 apparent beam candle power.

[illegible]

The secret of proper counterbalancing for any class of locomotive in any service is to reduce the weight of the reciprocating parts as far as possible. They should be made lighter than the average practice formerly in use. Special designs of piston heads, cross-heads, hollow piston rods, and the use of high grade materials, including heat-treated carbon and alloy steel, aluminum, etc., make it possible to construct very light parts, the expense of which will be many times justified by the consequent saving in repairs to equipment and track, as well as the saving due to the increase in the tractive power of the locomotive. With a refinement of design along these lines, it is altogether possible to construct reciprocating parts approaching in lightness 1/240 part of the total weight of the locomotive in working order, instead of 1/160 part as expressed in representing a fair average. With an increased tendency toward these very light parts, the percent-

age of parts balanced or unbalanced becomes less and less a factor. Greater efficiency is thus given to the locomotive, in that more and more of the weight allowable on the rail will be used in starting and pulling the train.

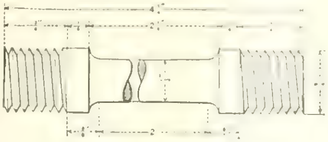
The committee presented all this, and more than this, in a very clear and interesting manner, and in a series of tables show the marked improvement that had been made in the lightening of the parts, and the consequent nearer approach to an even counterbalancing of the modern locomotive.

MAINTENANCE AND OPERATION OF ELECTRICAL EQUIPMENT.

The report of the committee on this subject was particularly interesting in view of the fact that it brought out very prominently the truth that experience in maintaining steam equipment is the best possible training for the new responsibilities involved in handling electrical equipment, about the only additional requirement being an ability to understand and use intelligently the necessary electrical terms. Indeed all classes of mechanics who have been accustomed to the strenuous service involved in steam locomotive work, if free from pride and prejudice, admit that in electrical work their yoke is easy and their burden is light. The mechanical appliances used are almost identical, and no master mechanic who is successfully maintaining steam rolling stock need hesitate to undertake the maintenance of electric equipment. Of interest also was the report of the extent to which steam railroads have been electrified. In January, of the present year, electrification on parts of 14 steam railroads to the extent of 591 route miles, including 1,761 miles of track had been accomplished. Whether the change will pay or not is still an open question. Certain it is that any changes in the future need not be feared by the accomplished steam engine men. A few days' instructions to locomotive engineers and firemen qualifies them for regular electric, and as for machinists and others, the work is simply lighter and cleaner.

FORGING SPEC[illegible]

The committee presented a very full report on the methods of testing forgings. Briefly, it may be stated that the elastic limit in tension tests for carbon steel forgings whose diameter or thickness is not over ten inches, when solid, should be 50,000 pounds per square inch, and a tensile strength of 85,000 pounds per square inch. The elastic limit should be determined by means of an extensometer of a type the equal of the "Berry" strain gage. The speed of the test machine should not exceed one-eighth of an inch per minute until the elastic limit has been reached. The ten[illegible] specimen should be of the form and dimensions shown in the accompanying illustration.



FORM OF TENSION TEST SPECIMEN

VARIABLE EXHAUST.

An individual paper was presented by Mr. J. Snowden Bell on the above subject. The paper was of much historical interest and showed how carefully the author had conned the subject. Beginning with Trevithick's locomotive in 1803, Mr. Bell followed the development of the exhaust pipe and nozzle up to the present time, and it is no joke to say that the members "gazed and still the wonder grew, that one small head could carry all he knew." The drawings exhibited showed that some of the designs were fearfully and wonderfully made. In their day they served a double purpose, first in giving the inventors an opportunity to claim fuel saving, and secondly to give an opportunity for the inventors to occupy their spare time and probably keep them out of mischief. As to their merits, multitudes of witnesses are quoted as stating that the devices were removed—the results did not warrant their continued use—very much disappointed in results obtained—none of them sufficiently satisfactory to be retained in use. Mr. Bell ransacked foreign countries, but from the far ends of the earth it was the same story—great promises and poor fulfillment. But the lamp of hope is still burning, and the end of the variable exhaust nozzle, with all its complex cranks and levers and tendency to gum up and stick fast is not yet. Many believe that a variable exhaust properly constructed, automatically operable, fool-proof and independent of the human factor, would be successful. All we know is that it hath not yet appeared.

[illegible]

The committee on superheater locomotives did not present any printed report, but contented themselves by submitting the results of tests made by the Pennsylvania, and which were endorsed by the committee. The tests alluded to showed a saving of 20 to 25 per cent. in coal and water by the use of superheater appliances in actual service. The report pointed out that if maintenance is neglected and careless handling of the device while in service is permitted, the appliance becomes almost useless as far as any saving of fuel is concerned. The use of the pyrometer was favored by the committee, as it had been observed that the engineers and firemen were much interested in its use, and its more general adoption as an educational adjunct would in a short time be amply repaid. The full throttle opening, with judicious use of the reverse lever, was also urged in the use of locomotives equipped with superheating apparatus.

SUBJECTS.

The Committee on Subjects reported that special committees be assigned to the following subjects and report at the meeting of the Association in 1916:

1. Equalization of long locomotives, so as to secure the most effective guiding from the trucks, both leading and trailing.
2. Best practice and type of tender truck for passenger locomotives. Has a swing truck any advantage over a rigid truck?
3. Reciprocating and revolving weights. Committee to report on possibilities of lightening.
4. Transmission of electric power from motors to driving wheels of electric locomotives. Committee to report on the progress in this direction.
5. Use of pyrometers on superheater locomotives.
6. Piston valves, rings and bushings. Best material and sizes, with particular reference to superheated steam.
7. Metal pilot designs.
8. Modernizing existing locomotives, which can then remain in service for ten or fifteen years.

That the following subjects be assigned for topical discussions:

1. Advantages, if any, of compounding superheater locomotives.
2. Side bearings on tenders.
3. Tender derailments: Causes and remedies.
4. Road instruction for enginemen and firemen.
5. Crosshead design.

[illegible]

The election of officers for the ensuing year resulted as follows: President, E. W. Pratt, A. S. M. P. Chicago & Northwestern; first vice-president, William Schlafge, Gen. M. S. of the Erie; second vice-president, W. J. Tollerton, Gen. M. S. of the Chicago, Rock Island & Pacific; treasurer, Angus Sinclair; secretary, J. W. Taylor, Karpen Building, Chicago, Ill. Members of executive committee: C. H. Hogan, J. F. De Voy and J. T. Wallis.

The attendance, although not as large as last year, was equal to the average of the last four or five years, about 370 railroad men registering.

The retiring president, Mr Gaines, was presented with a past-president's badge indicating the degree of esteem and affection in which he is held by the members of the association. Much sympathy was also expressed towards Mr. Gaines in view of the fact that he had not been in his usual good health.

Annual Convention of the Master Car Builders' Association

[illegible] the Master Car Builders' Association was held in the Greek Temple on the million-dollar pier, Atlantic City, N. J., on June 14, 15 and 16. Mr. D. F. Crawford, Gen. S. M. P. of the Pennsylvania Lines West, presided, and opened the proceedings of the Association with an able address wherein he reviewed the important work that the Association had already accomplished and expressed an assurance of a continuance of earnest endeavor along the lines already mapped out in the records of past years. Many of the reports were remarkable in the degree of fullness with which the subjects were presented, but as copies had been furnished to the members in advance, it was not deemed necessary that the chairmen of the various committees should read the entire documents. The chairman had the happy faculty of disposing of the business expeditiously so that every subject reported upon had a fair measure of discussion, and the result on the whole was of the most gratifying kind, and a considerable [illegible] made toward the standardization and improvement in [illegible] of the details of car construction.

The following are condensed reviews of the leading reports, and it may be added that the recommendations embodied were, as a rule, adopted.

[illegible]

Prof. Charles H. Benjamin, of Purdue [illegible] shoes of different materials and construction had been tested on the Master Car Builders' machine at Purdue University, at various speeds ranging from 20 to 80 miles per hour, and under pressure of ap[illegible]. From the tabulated results of tests it appeared that the coefficient of friction diminishes [illegible] but that for pressures from 12,000 to 18,000 pounds inclusive, the difference is slight. It is furthermore apparent that pressure in excess of 18,000 pounds is not economical. [illegible] position shoes is in all cases considerably greater than the average for the other [illegible] excess. The materials of the brake shoes [illegible] could be easily drilled; chilled cast iron, [illegible] shoes with inserts of harder material, and shoes having a cast iron shell filled with a [illegible]

beams the committee reported that in its opinion no change should be made in the present specifications.

COUPLERS.

The committee on couplers, of which Mr. R. L. Kleine was chairman, presented a voluminous report extending to 160 pages, with numerous diagrams and illustrations showing results of tests on a great variety of couplers and the consensus of opinion was that the couplers have not been in service a sufficient length of time to determine all the weak points or the seriousness of the defects that have been

D. F. CRAWFORD

[illegible]

developed. It is also the general [illegible] expressed in [illegible] from thirty-two railroads having these couplers in service. The replies were received in response to a circular letter to all roads conducting service trials. The average life of the couplers on which reports were at hand, with repairs, was 7 months and 11 days. The committee expressed their indebtedness to the coupler manufacturers who are working jointly in the establishment of the standard coupler, and particularly the American Steel Foundries and the National Malleable Castings Company, who placed testing facilities at the [illegible]

[illegible]

The most striking feature in the report of the committee on car wheels was the high percentage of wheels removed from [illegible] 625-pound type reputed cracked and broken, 63.6 per cent. were under refrigerator cars. The failure of wheels under this class of equipment is out of all proportion to the number of cars. The failures were chiefly under cars of a gross weight of 105,000 pounds or more, which weight is considerably in excess of that supposed to be carried by these wheels. The overloading, however, does not entirely explain the situation. The breaking and cracking of plates of cast-iron wheels occurs to a large extent on roads having long and heavy grades, and the heating due to the continued application of the brakes is undoubtedly largely the reason for failures of this nature. The committee especially desired to call the attention of the association to recommendations made in previous reports, that wheels of the proper size be used, especially under refrigerator car equipment, as at the present time many cars are running lighter wheels than are proper, in accordance with the standards of the association.

CAR CONSTRUCTION.

An elaborate report including over 30 plates, was presented by the Committee on Car Construction, and it was clearly pointed in the matter of freight car designs a large number of failures was traced directly to weak center-sill construction and incorrect analyses of draft gear effect on center-sill construction. The engineering formulæ presented embraced the complete details of requirements from which the engineering department of any road could apply the same to specific designs. Methods of reinforcing existing wooden cars were shown so that they would come within the requirements. Many roads are at present modifying wooden cars, which makes it desirable to have a guide for minimum strength requirements for reinforcement of existing wooden cars to fit them for some years' further service.

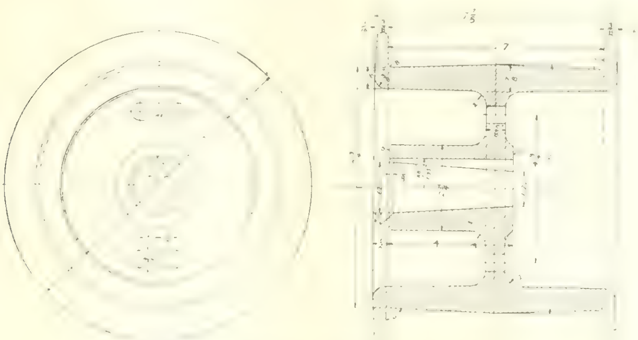
SPECIFICATIONS AND TESTS FOR MATERIALS.

In addition to the specifications and tests for materials submitted and adopted at previous meetings of the Association, the committee this year presented a considerable amount of new matter to be added under the sub-head of "Physical Properties and Tests," among which is a section entitled "Digester Test." It appears that there has been some misunderstanding by the manufacturers as to just how this test of hose should be made under the original wording of paragraph on "Tests for Steaming." The recommendation sets forth that the digester shall consist of a cylinder containing dry

saturated steam at a pressure of 45 pounds per square inch. The hose shall be put into the digester and will remain there 48 hours continuously. An examination of this section, after being submitted to the heat of the steam, should not disclose any blistering of the inner tube or any loosening of the tube from the fabric. Examination and test after heating will be made as soon as possible after the specimen has cooled for 24 hours. The tests will be made at a temperature of not less than 60 degrees F. The Canadian Pacific has conducted tests showing the present standard specifications amply protected the purchaser against stiff hose under freezing conditions.

TRAIN LIGHTING.

On the subject of Train Lighting the committee expressed an opinion very strongly in favor of the standardization of armature pulleys. At present, on some of the roads where there is considerable change of equipment, it is necessary to carry in stock at terminals as many as twenty different designs of axle dynamo pulleys in order to meet the requirements of the service. The committee are hopeful that the necessity for establishing a standard will bring about the desired result, and have been in communication with the representatives of the various axle dynamo manufacturing companies. Appended is a plan of pulley submitted for approval. It was also recommended that in wiring cars for electric lighting, all the wire shall be run in conduits, and the conduit shall be so installed that the wires can be pulled in and pulled out of the conduit after the car is completed. Regarding the method of wiring electric-lighted cars, the committee felt that it would be desirable for the coming year's work to endeavor to outline general specifications for wiring of cars for the guidance of the railroads and car builders, in view of establishing such practices as will minimize the possibility of defective wiring, thereby resulting in economy.



[illegible] AXLE DYNAMO PULLEY.

DRAFT EQUIPMENT.

The committee reported that sixty per cent. of the total number of cars are of steel center sill construction and are equipped with friction draft gear from a minimum of 100,000 pounds to a maximum of 260,000 pounds capacity. The capacity of these varies from 80,000 pounds to 120,000 pounds. The question is involved whether the construction of a car is taken into consideration when a decision is being reached as to the capacity of the gear to be applied. It is evident that a draft gear of low capacity necessitates a better construction of car in order to take care of the shocks which are meant to be absorbed by the gear. Eighty per cent. of the replies received by the committee to the questions sent out, showed a preference for friction draw gear on new equipment. Thirty-six per cent. showed a preference for more coupler travel than the present travel in the present standard of 2¾ inches between coupler horn and striking plate. A metal striking plate is preferred on new equipment and the vote was equally divided between metal and wood and metal striking plate on old cars. The cast steel carry-iron is preferred for new equipment and the wrought iron for the old equipment.

TRAIN BRAKE AND [illegible]

The committee reported that the proposed type of conductor's valve submitted at last year's Convention had not been approved of. The subject of hand brakes for heavy passenger cars had engaged the attention of the Committee during the year, but no designs examined seemed to be entirely satisfactory. What is needed in a hand brake rigging for heavy cars is one that will take up quickly all slack in the brake chain and bring the shoes in contact with the wheels, means for easily increasing the leverage sufficiently to permit of the average man producing the required brake force, this increased leverage to come into play when the shoe movement is practically little or nothing. The question of whether it would not be better to divide the hand brake so as to have it operate on a single truck has arisen and in the judgment of the committee there is much to recommend serious consideration of this plan, since it permits of a reduction in the total leverage and enables the operator to apply the brake on the single trucks with an effectiveness in excess of what is obtainable where the brake operates on both trucks, and what is very important, this effectiveness is obtained in much less time.

PRICES FOR LABOR AND MATERIAL.

The committee on the above subject recommended that the passenger car price rules be the same as freight car prices. Below is an abstract of the prices recommended for both freight and passenger car axles and wheels when average scrap credit prices must be allowed for wheels removed from dismantled cars:

One axle, 50,000 lb. or under......	$1.65
One axle, 60,000 lb................	2.00
One axle, 80,000 lb................	3.00
One axle, 100,000 lb................	3.70
One axle, 140,000 lb................	4.50
One cast iron wheel, 50,000 lb or under	2.75
One cast iron wheel, 60,000 lb......	2.90
One cast iron wheel, 80,000 lb......	4.75
One cast iron wheel, 100,000 lb......	4.75

[illegible]

The active membership as reported by the secretary is 429, representative members and others, 534, making a total membership of 963. The executive committee recommended that the dues of active members be fixed at five dollars per year, and representative members at seven dollars. The recommendation was adopted. Sixty-six railroads and private car lines were added during the year to the list of subscribers to the rules of interchange.

The election of officers for 1915-16 resulted as follows: For president, D. R. MacBain, Supt. M. P. & R. S. New York Central Lines, West; first vice-president, R. W. Burnett; second vice-president, C. E. Chambers, Supt. M. P. Central Railroad of New Jersey; third vice-president, T. W. Demarest, Supt. M. P. Pennsylvania Lines, West; treasurer, J. S. Lentz, M. C. B. Lehigh Valley Railroad; executive members, C. E. Fuller, Supt. M. P. Union Pacific Railroad; F. E. Gaines, Supt. M. P. Central of Georgia Railroad; I. S. Downing, Gen. M. C. B. Cleveland, Cincinnati, Chicago & St. Louis Railway.

The retiring president, Mr. Crawford, was presented with a past-president's gold badge amid cordial assurances of the good will and esteem, to which Mr. Crawford very feelingly and fittingly replied, and the convention closed with high hopes of future achievements.

Catechism of Railroad Operation

Locating Pounds and Keying Up Rods, and Disconnecting for Broken Rods and Levers

NEW SERIES

Third Year's Examination.

(Continued from page 123, April, 1915.)

Q. 186.—How do you place engine to locate pounds in main rod brasses and why in that position?

A.—Place engine on bottom quarter on side to be tested, set brake, admit steam to cylinder and work reverse lever back and forth, watch brasses. We place the engine on bottom quarter so as to have the pin between two rigid points, and then any lost motion in brasses will show before box would move or the wheel slip.

Q. 187.—Where do you place engine to key *back end* of main rod and why there?

A.—On [illegible] center so as to key brasses against largest part of crank pin.

Q. 188.—Where do you place engine to key front end of main rod brasses and why there?

A.—On top or bottom quarter. Generally *bottom quarter* so as to key against largest part of pin, and on bottom quarter because it is easier to get at set screw that holds front end key.

Q. 189.—What would you do if the main rod broke?

A.—Remove broken parts and disconnect valve rod and block valve to cover admission ports, block crosshead, remove cylinder cocks, put collar on main pin and provide for lubrication.

Q. 190.—What would you do if the [illegible]

A.—Remove broken parts, disconnect valve rod, block valve to cover the admission ports and proceed. Note:—Most likely the piston would have gone out through the front cylinder head.

Q. 191.—What would you do if front cylinder head broke?

A.—Disconnect valve rod, block valve with back admission port slightly open, remove back cylinder cock. Note:—Do not take down main rod. Note:—If in dusty weather, would cover front end of cylinder with gunny sack or boards. Another way: Disconnect valve rod, block valve centrally on its seat, remove back cylinder cock, board up front end of cylinder, placing a swat of waste saturated with oil in cylinder. Another way: Disconnect valve rod, block valve centrally on its seat, disconnect main rod, [illegible] head.

Q. 192.—[illegible] motion explain how you could disconnect for broken eccentric, eccentric rod, or [illegible]

A.—Disconnect eccentric rod and remove other broken parts, disconnect back end of radius rod and block link block in center of the link. Note:—When blocking link block in link of Walschaerts valve gear block above and below it in slot of link.

Q. 193.—What would you do if link trunnion pin broke?

A.—Take down eccentric rod, disconnect back end of radius rod and block link block in center of link, then wedge the link in place by driving wedge between trunnion pin bracket and link on side where the trunion pin is broken.

Q. 194.—What would you do when link trunnion pin bracket breaks?

A.—Take down eccentric rod, disconnect both ends of radius rod and take link and radius rod out, block valve centrally on seat, provide for lubrication and free circulation of air in cylinder. Note:—If link cannot be readily removed, support forward end of radius rod and chain link so as it will carry, allowing back end of radius rod to carry with link block at bottom of link.

Q. 195.—What would you do with broken valve stem or valve yoke of Walschaerts valve motion?

A.—Block valve centrally on seat, disconnect forward end of radius rod and support it underneath the running board, provide for lubrication and free circulation and proceed. Note:—With link block in center of link and combination lever (lap and lead lever) at right angles to it the valve will be centrally on its seat. Note:—To secure the valve centrally where yoke or stem is broken, locate the central position, clamp valve stem then remove the vacuum valve and block it against the valve, or if it is a piston valve, remove the front head to valve chamber and cut piece of board (that is nearly [illegible] the diameter of valve chamber) to fit between valve in central position and head of valve chamber. Note:—Some desire as an extra precaution to stop all motion of radius rod when front end of it is disconnected and supported up. To do this you may remove eccentric rod, or disconnect back end of radius rod and block link block in center of link. Note:—When the forward end of radius rod is supported and eccentric rod is taken down, the link block does not always move freely in link and at times bothers in handling the reverse lever, consequently the better way to stop motion of radius rod is to disconnect back end of it and block link block in center of link.

Q. 196.—What would you do in case of broken reversing lever? Reach rod or reversing arm, or lifting shaft, Walschaerts valve gear?

A.—If reversing arm extended up through running board and was not broken, could block forward and back of it in slot in running board to hold link blocks at the desired point of cut off, otherwise would have to block above and below both link blocks in slot of link to hold link blocks at the desired point of cut off, necessary to start and handle train.

Q. 197.—What would you do in case of a broken radius arm or radius arm hanger?

A.—Remove the broken parts and block link block in slot of link to get the desired point of cut off to handle train. Note:—With the Walschaerts valve gear. Where one link block is blocked as above the other side may be worked at a longer or shorter cut off as desired.

Q. 198.—What would you do in case of a broken radius rod?

A.—Remove the broken part from the combination lever—support the forward end of radius rod, secure valve centrally on seat, provide for lubrication and free circulation in cylinders and proceed. Note:—Absolute safety is provided by disconnecting back end of radius rod and blocking link block in center of link.

Q. 199.—What would you do in case of a broken lap and lead lever, union link or crosshead arm?

A.—Remove broken parts necessary, block valve centrally on its seat, support front end of radius rod, provide for lubrication and free circulation and proceed. Note:—Where lap and lead lever is not broken the lower end of it may be secured to back cylinder cock. Note:—Many engines have the front end of radius rod constructed so it can be connected to back end of valve rod, when the lap and lead lever is taken down. On such engines it is a good plan in accidents of this kind to make the connection between radius rod and valve rod. This will give enough movement to valve to provide the lubrication to cylinder but will not aid much in handling the train because the eccentric only moves the valve far enough to open ports wide if the valve had no lap, and the engine working full stroke, and as the cut off is shortened by hooking up of lever so is travel of valve shortened and with lever hooked up the lap of valve would prevent much port opening and the angularity of main rod would cause an unequal distribution, so the actions of steam on disabled side would be erratic at the best, and the ports would only be open a very little and for only an instant when cranks were passing the quarters on the disabled side.

Q. 200.—What would you do in case of a broken crosshead, crosshead pin, main rod or main rod straps or brasses, Walschaerts valve gear?

A.—Disconnect main rod and remove other broken parts necessary, put collar on pin, secure valve centrally on its seat, disconnect forward end of radius rod and support it. Block crosshead at back end of guides, remove cylinder cocks and proceed. Note:—The motion of radius rod may be stopped if desired as explained before.

Q. 201.—What would you do if main rod crank pin broke?

A.—Block valve centrally on its seat, disconnect and support forward end of radius rod, take down eccentric rod and remove straps and brasses at back end of main rod; block crosshead at forward end of guides and carry main rod in guides. Take down all side rods and remove cylinder cocks on disabled side.

Q. 202.—What would you do if piston rod broke?

A.—Secure valve centrally on its seat, disconnect and support forward end of radius rod. Take off cylinder head and remove piston from cylinder. Motion of radius rod may be stopped if desired.

Q. 203.—How would you handle a piston valve if stem were broken inside of valve chamber?

A.—Get valve rod at right angles to rocker arm, clamp valve stem, remove front valve chamber head and push valve back against stem, then cut piece of board or plank (that is nearly as wide as the diameter of valve chamber) to reach from valve head and screw head against it. Disconnect valve rod, provide for lubrication, free the cylinder and proceed.

Q. 204.—What is the necessity of keeping brasses keyed properly?

A.—To prevent pounding and to keep the rod the proper length.

Q. 205.—How should main rod brasses be keyed?

A.—They should be keyed as close as possible to avoid pounds and so they will move freely on pin at all points in the revolution.

Q. 206.—Describe a piston valve.

A.—It is a hollow spool-shaped casting with packing rings (in the heads that form its ends) that make a steam-tight joint with the walls of the valve chamber.

Q. 207.—What is the relative motion of the piston and valve for inside admission valve? For outside admission valve?

A.—The inside admission valve moves in opposite direction to piston for admission and with the piston for cut off, expansion and exhaust. The outside admission valve moves with the piston for admission and in the opposite direction for cut off, expansion and exhaust.

Questions and Answers

Vacuum in Ash Pans.

H. M. S., Coteau Junction, Quebec, and C. M. W., Ottawa, Canada, asks particulars in regard to a device for determining amount of vacuum in ash pans. A.—The device is the invention of Mr. W. C. Hayes, Superintendent Locomotive Operation, Erie railroad, and consists in applying a pipe 1¼ in. in diameter, in the center of the ash pan, diagonally, or crosswise of pan, pipe to be perforated with two sets of holes, drilled at an angle of 45 deg., holes to be ⅛ in. in diameter. The pipe should be as near the grates as possible, so as not to interfere with shaking of grates, and small holes set towards the grates. A cap is placed on one end of the pipe, and the other end of the pipe reduced to ⅝ in., and a ⅝-in. pipe is run to the cab on the left side. A vacuum tube, bent in the shape of the letter U, the lower part being of metal and the upper arms being of glass, is placed at a suitable point in the cab and the ⅝-in. pipe from the ash pan is attached to one of the upper extending arms of the vacuum tube. There is atmosphere pressure on the water in both glasses, and when the engine is in operation, and the water rises in the glass to which the pipe is attached, it indicates that a portion of the atmosphere pressure is being taken from the top of the water in that glass; the atmospheric pressure on top of water in other glass will force the water down an equal distance. If the water rises 1 in., it also lowers 1 in. in opposite glass, and so on. The purpose of the vacuum tester is to ascertain whether a locomotive is getting free circulation of air in the ash pan. Repeated experiments conducted under the supervision of Mr. Hayes has shown that there is not sufficient air being admitted into the ash pan when the water in the vacuum tube varies over ¾ in., and the nearer that the water remains perfectly level, the nearer perfect combustion is secured. A record of tests and drawings of the device were published in the February, 1914, issue of Railway and Locomotive Engineering.

Increase of Volume by Superheating Steam.

W. H. B., Leeds, England, writes: "Taking saturated steam at a given pressure, what is the formula by which the increase in volume can be ascertained when the steam is superheated?" A. The following formula gives the increase in the volume of steam due to superheat:

$$PV = BT - P(1 + AP) [illegible] \; T$$

Where B = 47.10, A = [illegible] 0.0052, P = pressure in kilogrammes per square metre, V = volume in cubic metres, T = absolute temperature in degrees C., C = 0.031. For ordinary purposes an abbreviation of this formula may be used, as follows:

$$PV = 47.10\ T - 0.016\ P.$$

Approximately, the measure in volume due to superheating may be taken at 12½ per cent. for every 100 degrees, Fahrenheit, of superheat added.

Flexible Wheelbase of a Locomotive.

W. S. J., Cleveland, Ohio, asks:—What is the flexible wheel base of a locomotive? How would you measure to get the flexible wheel base of a locomotive? A. The flexible wheel base of a locomotive is the distance between the centers of the front and back truck wheels of a locomotive, if there be any. For example, in the description of a Mikado, 2-8-2, locomotive for the Nashville, Chattanooga & St. Louis, which appeared in the May issue of Railway and Locomotive Engineering, there are four driving wheels on each side, and the distance between the center of the front and the back driver is 15 feet 9 inches. This is the rigid wheel base. There are also two truck wheels on each side, and the distance between the centers, on a straight track, is 34 feet 4 inches. This may properly be called the flexible wheel base, as some of the wheels are movable in their relation to each other.

Double Heading Valve.

F. A., Queensland, Australia, writes: "On page 15, January issue, Mr. W. K. Davis, R. F. E., T. & O. C. Ry., describes a double heading air brake valve, and in the last paragraph a sentence reads, 'when the first engineer releases the brakes, forcing the air back through the train line, it also moves the piston towards the left and opens the valve, etc.' Is this correct or a misprint, or have I failed to understand the operation of the device?" A. At this time we are unable to state positively whether this is a misstatement on the part of the author or a misprint, and while the description is not as comprehensive as it might have been, the drawings indicate the simplicity of the device, and from them our understandings of its operation agree in that the sentence should read in part, "it also moves the piston toward the right," as shown in Fig. No. 2.

Securing Tool Handles.

Fill the socket in the wooden handle with powdered resin and a little pumice stone. Heat the tang of the file or other tool and press it firmly down into the handle. When cold it will be found to be firmly set.

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The Railway Mechanical Conventions.

[illegible] opening address President Gaines of the [illegible] Association, ventilated a subject which has frequently occupied the attention of both associations, namely, the idea of bringing both associations into more intimate relationship that they have occupied in the past. The past proposals in this respect have [illegible] association, the other associations to be divided into sections dealing with the subjects that each one was most competent to manage. The supreme association would have the duty of establishing fixed standards, the arranging of methods and specifications and of general supervision of the work to be done by the other mechanical organizations.

The scheme is highly attractive, but we do not think it likely to go beyond being outlined. It takes two to make a bargain and we do not believe that the numerous railroad mechanical organizations are prepared to accept guidance and inspiration from the Master Mechanics' Association, although it is the oldest railroad mechanical organization except Master Car Builders. The principal associations necessary to adopt Mr. Gaines' scheme are the Traveling Engineers, the Air-Brake Association, the International Railway General Foremen, Association of Railway Electric Engineers, and the International Fuel Association, all robust organizations, besides several others that are less important. We imagine there would be timely objections offered in these associations should all of them be asked to apply to the American Railway Master Mechanics' Association for directions concerning the work they are authorized to perform. In our judgment, the difficulties of carrying out such a plan are insurmountable, but we believe it would promote railroad interests were the various mechanical organizations put into one working unit.

The remaining recommendations made by Mr. Gaines were of an educational character and ought all to be adopted by railroad companies. He strongly favors the higher education of boiler inspectors, shop foremen, engineers and firemen, and desires that more thorough examination of firemen should be passed to entitle them to promotion to the position of engineer.

President D. F. Crawford in his opening address to the Master Car Builders convention stood up for greater authority being given to the association than it has hitherto exercised. The Master Car Builders' Association has done wonderful work, but greater results can be achieved by more closely co-ordinating the work and rules of the several associations having to deal with different phases of car construction and operation, and we should seek to establish closer relations with the American Railway Association, the Association of Transportation and other traffic organizations. President Crawford also recommended the members of the Master Car Builders Association to observe more closely the proceedings of such voluntary associations as the Air-Brake Association, the Car Founders' Association, Interchange Inspectors' Association and others of a similar character.

Toward the conclusion of a lengthy address President Crawford said: "For future work of the association, three items seem to me to stand out prominently from a great mass.

"1st. Standardization of equipment. Much indeed has been accomplished, but up to the present time attention has been largely devoted to dimensions and details. Of course, each detail decided upon gives promise of ultimately reaching a conclusion on the larger problem, but is not now the time for this association to agree on standard freight car trucks, standard box, stock, refrigerator, hopper, gondola and flat cars? We all remember the letter written by Mr. Ripley, president of the A. T. & S. F. Ry., on this subject, which was read at the convention last year. Can we not by concerted efforts, adopt standards which will make unnecessary and stimulation?

"2nd. Simplification of the rules of interchange. One has but to read in the report of the arbitration committee the suggestions they receive as to changes in the rules, to fully realize how much has already been accomplished in this direction, but I trust they will harden their hearts and make even less changes than they have in the past. The members can assist them very much indeed by confining their recommendations for changes to those items only which are frequently involved.

"3rd. Co-operation with the American Railway Association in expediting the movement of cars.

"Mr. E. S. Jackman writing of railroads, says: 'A railroad is a disciplined power; owning rails and cars and locomotives; engaging the highest quality of mechanical skill and expert knowledge; but the glory of a railroad is the united adjustment of its living nerves to patience, courtesy, speed and safety.' Gentlemen, the Master Car Builders' Association assisted largely in making it possible for the writer of these words to pay his graceful tribute to railroads the world over."

Against Public Ownership of Railroads.

We read remarks periodically concerning the advantages that would come to the public if national ownership of railroads were achieved. The people who advocate this idea are nearly always persons who are hankering after receiving services which they do not wish to pay for. At an annual banquet of the Jacksonville (Fla.) Traffic Club, several speakers expressed themselves on the subject of government ownership of railroads. Some of the speakers expressed themselves very emphatically against increased government control of transportation, one of them speaking as follows:

"There is no reason for the government of the United States engaging in private business. Government ownership destroys private interests. The business of the government is politics, and in conducting [illegible] business it [illegible]

revenues and profits. It is equally easy to govern with other people's money. While business men in all lines have been economizing in every way possible during the present war and hard times, see what happened at the postoffice department! This is one great business of the government that really shows a profit. The postmaster general wanted to save the trifling sum of $7,000,000, but 44,000 rural postal employees objected, they wanted their pay raised, and they got it. When 44,000 people in hard times like these can affect the entire nation, what would happen if the million and one-half federal employees united with the three million other employees now working for private concerns and were suddenly transported under government ownership? They would control the balance of power in the country. There would soon be no business—it would be all politics. You cannot legislate for New York state, and make those laws suit the people of Florida."

Practical Fuel Saving Scheme.

One of the most energetic railroad men of our acquaintance is Mr. William C. Hayes, superintendent of locomotive operation of the Erie Railroad. Mr. Hayes is not a man contented to follow the routine duties of his position. With him something must always be doing to improve the service he superintends. His latest scheme for improvement casts into the shade previous substantial achievements of the past, such as the saving of $30,000 on the fuel bill on a single division in a single year, and four years ago at that. Similar and even improved results must have been established on all divisions of the road long ere this. The Erie is to be congratulated in having a man in charge of this work known for his determination not to rest on his oars, however justified such action might seem to be.

Mr. Hayes' challenge to his engine crews is in the nature of a proposal that they strive to return to the company through fuel saving and otherwise, though particularly by the former means, an economy representing 6 per cent., a fair rate of interest, on the sum which the road devotes annually in paying their wages which amounts to about $4,117,500. This would amount to the very appreciable saving of $247,000 per year. At first blush, this figure looks large and almost impossible of achievement in the fuel bill alone, but he reminds them that were each fireman to save one scoopful of coal, 15 pounds, per engine mile, which does not seem at all an unreasonable accomplishment, the total savings at the end of a year would be 337,500 tons worth $523,125—more than twice the amount represented by the proposed 6 per cent. saving on the total engine crew wages. Another deduction which he makes in issuing this challenge, and one which can hardly fail to leave its impress on the minds of the crews, is the conclusion which has been arrived at through careful investigation, that each of the road's locomotives discharge in the form of steam through the safety valves, the equivalent of 7,000 pounds of coal per month, a total of 42 tons per engine per year, or 67,000 tons for the entire road during the same period, amounting not only to a loss of $100,000 for the road, but represents a corresponding waste of water and just that much superfluous work for the men in having handled those quantities of water and coal to no purpose.

These factors have nothing to do with the quantities of oil and tools which every crew can economize on without difficulty practically every day of their lives, nor of the tremendous savings that would result from more careful handling of machinery and equipment. When the enginemen of the Erie Railroad arrive at a realization of the fact that the 6 per cent. Mr. Hayes asks for can be saved through effecting actually less than 40 per cent. of the economies he shows to be reasonable in the coal account alone, they must be indifferent even to their own best interests, not to give him a wholehearted response that will result in more than meeting his best expectations.

Dirty Shops.

The superintendent of a dirty shop is a natural relation of the slovenly woman who keeps a dirty kitchen. We have heard all sorts of excuses made for those responsible for dirty kitchens and dirty shops, but we have held only one opinion on the subject, viz; the wrong person is in charge.

"You do not act up to the principle that 'cleanliness is next to godliness,'" we remarked to a master car builder, as we stumbled with him to and fro about a shop that was macadamized with fragments of timber, bricks, greasy waste, worn out air hose, tatters of cushions, broken bolts, old brake shoes, dilapidated axle boxes, lumps of broken wheels, fragments of brake beams and no end of other litter. It was actually the dirtiest shop I had ever seen. "The company is too poor to employ men to clean up the place," was the answer, and it looked to the wanderer as if the condition of that shop alone was enough to help the company towards the hands of a receiver.

We advise men in charge of dirty shops to be careful not to receive visitors. We remember a case where a master mechanic named Nemo, made the impression at the railroad meetings that he was a man of energy and executive ability. A general superintendent, looking for a superintendent of motive power visited Mr. Nemo's place with the intention of finding out how the master mechanic would regard an offer to fill a higher position. But when the superintendent looked over the shop he made up his mind that the man in charge was a better talker than a manager of work.

Attempt at Rate Cutting by Railroad Commission.

A curious attempt at railroad rate cutting by the New York railroad commission is exciting much interest in the State named, and is likely to develop into national importance. The case is thus commented upon by the New York Times:

It is not only railway rates which must be reasonable. The regulation of rates itself must conform to the rule of reason, according to the decision of the New York Court of Appeals in the case of the Westchester commuters. The Public Service Commission ordered the increased rates of 1910 reduced to those of 1907, and the New York Central Railway appealed to the courts. The railway pleaded that it had shown reasonable cause for the advance, to wit, the betterment of the service and the increase of its costs, but that the Commission had refused to be convinced. The court prefers the case made for the railway. The fact that rates had been lower was no proof that the lower rates were reasonable, and the fact of the increase was no proof of the unreasonableness of the increase. The court thought that the comparison of rates was no conclusive argument regarding the reasonableness of either. Furthermore, the court thought the Commission wandered from its function of regulating rates and determining their reasonableness to the function, not its own, of imposing a rate policy on the company.

The Commission did not find that the increased rates were in themselves reasonable or unreasonable, but substituted a long argument regarding the policy of the company in making the increase. That was the company's business, not the Commission's. The welfare of the company was a matter for the determination of its management, under the direction of the owners, and was no concern of the Commission, whose order therefore is annulled. The decision is not final regarding these Westchester rates. The commuters still may show that the rates are unreasonable, if they can. They will be helped in a new proceeding by the present state of the law that the roads must show the reasonableness of rates. The case is interesting not so much because of the local fares involved, but because of the grounds of the decision that regulation must be reasonable, and that the Commission must not undertake the management of the companies whose rates they regulate. Those are new notes

in the [illegible] controversy, and it is time that they were struck. It is only a State decision, but it is by a court of high repute, and the basis of the decision will likely enough be influential in cases before the Interstate Commerce Commission.

The case has exceptional interest because the Legislature passed a bill designed to reduce these rates while the case was pending. Governor Glynn vetoed the law on the ground of the impropriety of the Legislature deliberately forestalling the action of the courts on a subject which the Legislature had committed to the authority of the Commission and the courts. Apart from the merits of the case, everybody except the commuters, who must pay the higher fares, and perhaps including some of them, must believe that the procedure of the court is preferable to that of the Legislature.

Work of a Model Fireman.

Ours is a model train, and a model fireman furnishes the power to keep it going. He throws in four or fire shovelfuls at each firing, scattering the coal along the sides of the firebox, shooting a shower close to the flue-sheet, and dropping the required quantity under the door. With the quick intuition of a man thoroughly master of his business, our model fireman perceives at a glance, on opening the door, where the thinnest spots are; and they are promptly bedded over. The glowing, incandescent mass of fire, which shines with a blinding light that rivals the sun's rays, dazzles the eyes of the novice, who sees in the firebox only a chaotic gleam; but the experienced fireman looks into the resplendent glare, and reads its needs or its perfections. The fire is maintained nearly level, but the coal is supplied so that the sides and corners are well filled, for there the liability to drawing air is most imminent. With this system closely followed there is no difficulty ex- [illegible] man. From the time he reached the engine, until the hostler takes charge at the end of the journey, he attends to his work, and to that alone; and by this means he has earned the reputation of [illegible]!

His rule is to keep the fire up equal to the work the engine has to do, never letting it run low before being replenished, never throwing in more coal than the keeping up of steam calls for. The coal is broken up moderately fine, a full supply being prepared before the firedoor is opened, and every shovelful is scattered in a thin shower over the fire—never [illegible]

and, as a result, they never succeed in making an engine steam regularly. Their fire consists of a series of coal heaps. Under these heaps clinkers are prematurely formed; and between them spaces are created through which cold air comes, and rushes straight for the flues, without assimilating with the gases of combustion, as every breath of air which enters the firebox ought to do.

From the information sent abroad at last Master Mechanics' convention we believe that the model handler of the coal scoop is about to be soon succeeded by one who has acquired the art of successfully operating a mechanical stoker. That is the latest indication of how the railroad world moves.

Radium Making in Scotland.

British scientists have been lamenting that the war in Europe has cut off the supply of radium which hitherto has been supplied almost exclusively from pitchblend found in Austria. It is now discovered that deposits of pitchblend found on the shores of Loch Lomond is likely to supply all the radium that Great Britain and America can use.

Radium which was discovered by Professor Curie, of Paris, is a new metal, which is supposed to possess extraordinarily valuable medical properties, being the most valuable of the radio-active substances. The "Scottish-American" publishes some notes on the production of radium as follows:

Some time ago Great Britain embarked upon the radium making industry, and has refined a certain quantity of the precious mineral. The war has virtually cut off supplies of foreign radium from that country, and they are now dependent on their own resources. The Scottish venture is due to the enterprise and energy of a Glasgow metallurgical chemist, Mr. John S. MacArthur, who has established his factory within easy reach of Loch Lomond. The founder of this latest industry, who has familiarized himself with the problems of his task, has been carrying out experiments with a small plant, and has trained a small staff of men for the work. The extraction and refining of radium from the crude ore is a prolonged and delicate operation, the material having to pass through about fifty processes. The proportion of radium per ton of the finest ore is about ten milligrammes, so that the yield cannot be described as heavy; but as the world's annual production of this rare radio-active agent is only about thirty grammes, it will be [illegible] possibilities for the new industry. It is anticipated that the Scottish plant will be able to turn out about six grammes per year. It is also intended to work upon the production of radium fertilizer as well as [illegible]

vanadium, since these articles are in demand, the last-named more specially, as the market for vanadium steel, of which vanadium forms a component, is increasing rapidly.

Prosperity from Advertising.

Every person familiar with the world's leading industries is aware that the makers of the Dunlop Company, famous for rubber tire making, is the most prosperous of all who have attempted that line of industry. One Glasgow agent, M. A. Fraser Sinclair, writing recently in the Glasgow *Herald*, says:

"One or two facts of the Dunlop publicity campaign may be mentioned. It is just over a quarter of a century since that campaign was inaugurated. The success of the bicycle in the immediately following years was largely due to the pneumatic tire, and Mr. Wilson tells that when he began business in 1894 there were no fewer than seventeen papers in the country dealing with cycles and cycling. Up till 1898 the Dunlop Company advertised in these alone amongst newspapers, but in that year they set aside £10,000 to be devoted to notices in the daily and weekly papers of the United Kingdom. The experiment was a success, and the list of newspapers now utilized by the company runs to nearly 300. After the first fortnight of the war the advertising of Dunlop tires was increased in the hope that, the inevitable reduction in the sales of motor cars notwithstanding, it would be found possible to keep the factories of the company running. The policy has justified itself, and today the orders are so many that, when combined with those from the government and the shortage of men due to enlistments, they have taxed the works to their utmost capacity. Here are some of the sayings in the article:

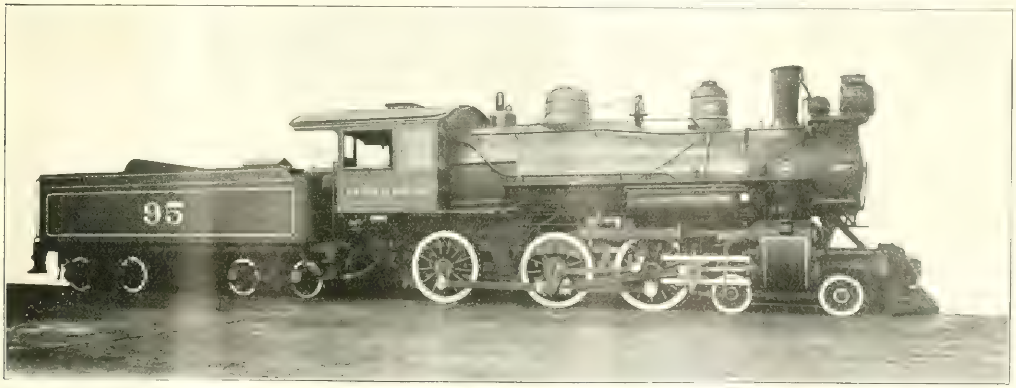
" 'Given two firms in active competition, the one which advertises skillfully and courageously will speedily outdistance the one that does not. The motor manufacturers who advertise best are the most prosperous. The public has a short memory, and it will be found when the demand becomes normal that the brands that have not been advertised will suffer, especially in favor of the American motor car manufacturers, who are fast increasing their advertising — and their sales—during the present period. The benefits of advertising are not restricted to the creation of immediate profits. Advertising makes valuable good-will. When the Dunlop Company was refloated for £5,000,000 in 1896 the public oversubscribed this colossal capital because the name of Dunlop had been so well advertised." And so on; a very interesting article, and full of sound, good sense, and another proof that the firm that is wisely and liberally advertised will be steadily and liberally patronized by a discerning public.

Ten-Wheel Locomotives for the Louisiana Railway & Navigation Company

Adapted for Either Freight or Passenger Service

An important trend in locomotive development, at the present time, is to improve the efficiency of motive power used in all kinds of service. The use of superheated steam is rapidly extending, and superheaters are now being applied to many locomotives of relatively moderate capacity. The result is not only a reduction in the consumption of fuel and water per ton mile of train hauled, but also an increase in the capacity of the locomotive in proportion to its weight. This feature is quite as important on lines where locomotive dimensions are limited by physical conditions, as on roads where the heaviest classes of power can be used.

The Louisiana Ry. & Navigation Co. has recently placed in service three superheater locomotives of the Ten-wheeled



TEN-WHEEL TYPE LOCOMOTIVE FOR THE LOUISIANA RAILWAY & NAVIGATION CO.
Thomas [illegible], Master Mechanic. [illegible]

type, which were built by the Baldwin Locomotive Works. These engines are used on 70-pound rails, and they can be turned on a 60-foot turn-table. The line is comparatively straight, with easy grades. Similar locomotives, previously built for this line, have proved most successful in freight service, hauling 2,500-2,600 tons on level districts, and 2,000 tons on grades of 0.4 per cent.

The new locomotives have 20 by 26-inch cylinders, and with driving wheels 58 inches in diameter and a steam pressure of 180 pounds, they exert a tractive force of 27,400 pounds. The total weight is 156,500 pounds, and of this the drivers carry 111,100 pounds. The ratio of adhesion is thus 4.05. The steam distribution is controlled by 12-inch piston valves, which are driven by Walschaerts motion. The cylinders are arranged for outside steam-pipe connections.

The boiler is designed for burning Illinois bituminous coal. It has a [illegible] firebox placed above the frames, and contains a 22-element superheater of the Schmidt type. The water evaporating surface is 1,786 square feet, and the grate area 28.5 square feet. The superheating surface amounts to 359 square feet. The proportions of this boiler are suitable for the use of a free-burning volatile coal, and are in accord with approved practice for superheater locomotives of this type. The Master Mechanics' standard front end arrangement is applied.

The tender is carried on arch-bar trucks, and has capacity for 6,000 gallons of water and 12 tons of coal. The engine and tender truck wheels are all of solid rolled steel, manufactured by the Standard Steel Works Co.

These locomotives are so equipped that they can, if desired, be used in passenger service. They are examples of a type which is unexcelled for all around duty, where locomotives of comparatively moderate capacity will suffice.

The following are the general dimensions of this type of locomotive:

Gauge—4 ft. 8½ ins.

Cylinders—20 x 26 inches.

Valves—Piston, 12 ins. diameter.

Boiler—Type, wagon top; diameter, 64 ins.; thickness of sheets, ⅝ in. and 11/16 in.; working pressure, 180 lbs.; fuel, soft coal; staying, radial.

Firebox — Material, steel; length, 102 3/16 ins.; width, 40⅛ ins.; depth, front, 71 ins.; depth, back, 67 ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, 5/16 in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space—Front, 4½ ins.; sides, 3½ ins.; back, 3½ ins.

Tubes—Material, steel; diameter, 5⅜ ins. and 2 ins.; thickness, 5⅜ ins., No. 9 W. G. and 2 in. No. 12 W. G.; number, 5⅜ ins., 22; 2 ins., 165; length, 13 ft. 11 ins.

Heating surface—Firebox, 163 sq. ft.; tubes, 1,623 sq ft.; total, 1,786 sq. ft.; grate area, 28.5 sq. ft.

Driving wheels—Diameter, outside, 58 ins.; center, 50 ins.; journals, main, 10 ins. x 11 ins.; others, 9 ins. x 11 ins.

Engine truck wheels—Diameter, 28 ins.; journals, 5½ ins. x 10 ins.

Wheel base—Driving, 14 ft.; rigid, 14 ft.; total engine, 24 ft. 9 ins.; total engine and tender, 57 ft. 7½ ins.

Weight—On driving wheels, 111,100 lbs.; on truck, 45,400 lbs.; total engine, 156,500 lbs.; total engine and tender, about 176,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. x 10 ins.; tank capacity, 6,000 gals.; fuel capacity, 12 tons; service, passenger and [illegible]

Engine equipped with Schmidt superheater. Superheating surface, 359 sq. ft.

Cement for Steam Pipes.

To make a permanent cement used for stopping leaks in steam-pipes where caulking or plugging is impossible, mix black oxide of manganese and raw linseed-oil, using enough oil with the manganese to bring it to a thick paste. Apply to the pipe or joint at leak. It is best to remove [illegible] ciently warm to absorb the oil from the manganese.

Air Brake Department

Empty and Load Freight Brake

[illegible] describe the [illegible] of the Westinghouse improved freight car brake we have diagrammatic views of the K-2-L triple valve and H-3 change-over valve in release, service and emergency positions from which the operation of the equipment will be explained, when the [illegible] is in "empty" position or when the car is unloaded.

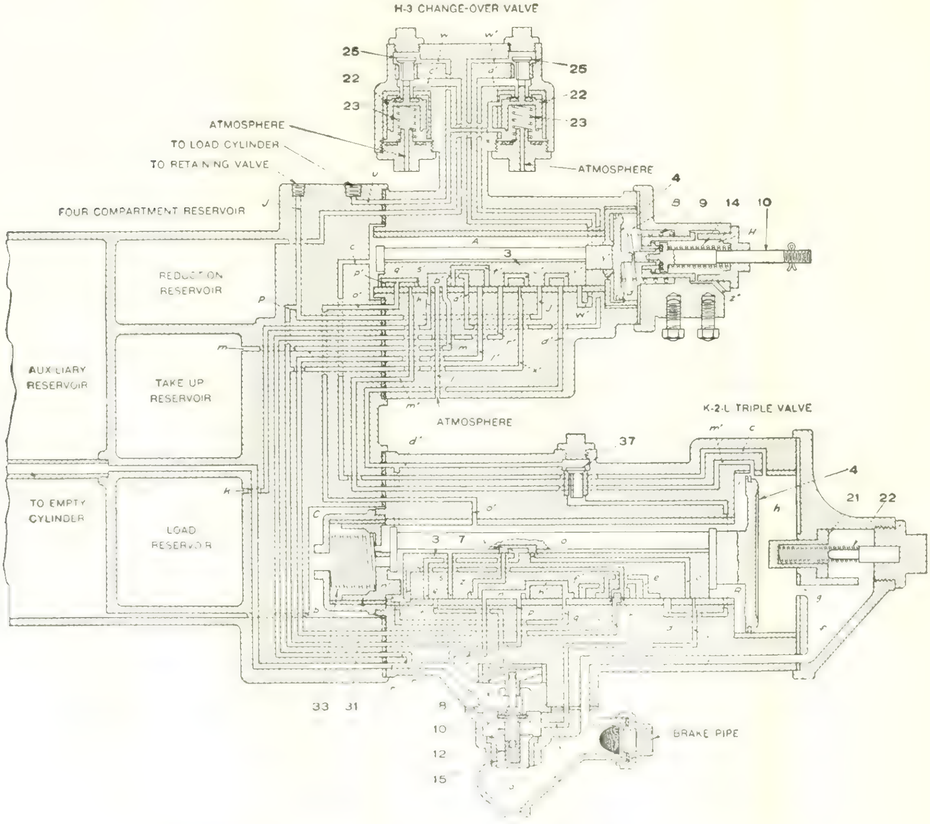
It will be understood that the diagrams [illegible]

[illegible] understood

We will also assume that the reader has either read our foregoing descriptions [illegible] ports and passages [illegible] by stating the duties of the various valves in their different positions, the student can readily trace the flow of air through the various valves and passages.

In release and charging position, it will be noted that brake pipe air enters the triple valve in the usual manner, flows through the cylinder cap to the triple piston cylinder thence through the feed [illegible] auxiliary reservoir. At the same time a port from the triple piston bushing leads to the slide valve bushing of the change over valve and brake pipe pressure entering the change-over valve is also free to [illegible] the chamber at the right of the change-over valve piston thus establishing an equilibrium of pressure on the change-over valve piston which permits the spring back of it to hold the valve in "empty" position.

In this position the auxiliary reservoir, the largest chamber of the four-compartment reservoir, is charged to the pressure carried in the brake pipe, while the "empty" brake cylinder is connected through the triple and retaining valve to the atmosphere. The load cylinder and reduction reservoir are open to the atmosphere through a port in a cap nut shown above the change over valve while the take up reservoir and load reservoir are open through the change-over slide valve to the atmosphere and these chambers and the load cylinder remain so during all operations when the car is empty, that is, the brake cut in empty position, and do not change or become charged until the operating lever is moved to load

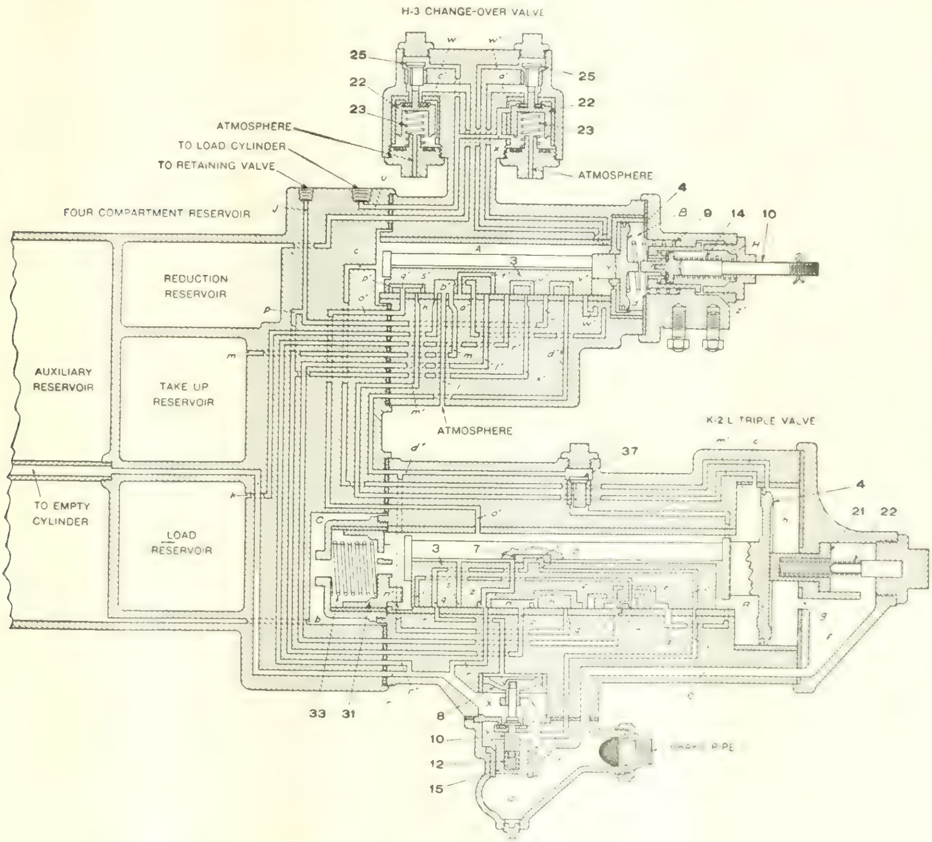


[illegible] POSITION

position which is done after the car is loaded. It will be understood that special instructions will be given to cover the cutting in to load or cutting out load of such brakes and expressions used here will merely refer to operation of the brake.

With the auxiliary reservoir charged, the brake is applied by making a brake pipe reduction faster than pressure can flow from the auxiliary back through the feed groove, thus creating a difference in the feed groove is closed, the slide-valve cuts off the brake cylinder from the retaining valve, the graduating valve admits auxiliary reservoir pressure to the brake cylinder and a small quantity of brake pipe pressure flows from the brake pipe through the graduating valve and slide valve past the emergency piston to the brake cylinder, making a local reduction of brake pipe pressure at each triple valve to hasten the serial reduction throughout the train. This feature of the type K brake cylinder is wide open, giving the maximum rate of service reduction in the auxiliary reservoir and maximum service rise of brake cylinder pressure.

When the brake pipe reduction ceases, after a light application, or if the point of equalization between auxiliary reservoir and brake cylinder has not been reached, the lowering of auxiliary pressure below that in the brake pipe permits the triple piston and graduating valve to be moved to what is known as lap posi-



SERVICE POSITION, [illegible]

pressure which will move the triple piston and slide valve to application position and whether the triple valve will move to quick service or full service position depends upon the rate of reduction, which is usually governed by the length of the brake pipe i. e. the length of the train.

If the rate of reduction is that usually encountered with long trains when the brake valve is in service position the movement of the triple piston and slide valve will be stopped by the graduating sleeve in the cylinder cap, and the valve assumes quick service position in which triple valve is so well [illegible] require no further explanation. If, however, the rate of reduction happens, as with a very short train, to be so rapid as to require no assistance from the quick service ports, the difference between auxiliary reservoir and brake pipe pressure will become great enough to force the triple valve against the graduating sleeve with sufficient force to slightly compress the graduating spring and allow the slide valve to move to full service position, in which the quick service ports are disconnected and the service [illegible] tion, where the graduating valve cuts the auxiliary reservoir away from the brake cylinder until a further reduction is made in the brake pipe. This movement to lap, or holding brake applied position, is the same in all triple valves and whether the valve returns to quick service lap or full service lap position, depends upon the previous position of the slide valve, the piston and graduating valve movement being the same in either case.

These K triple valves have two release positions, full release and retarded release, and the one assumed during a re-

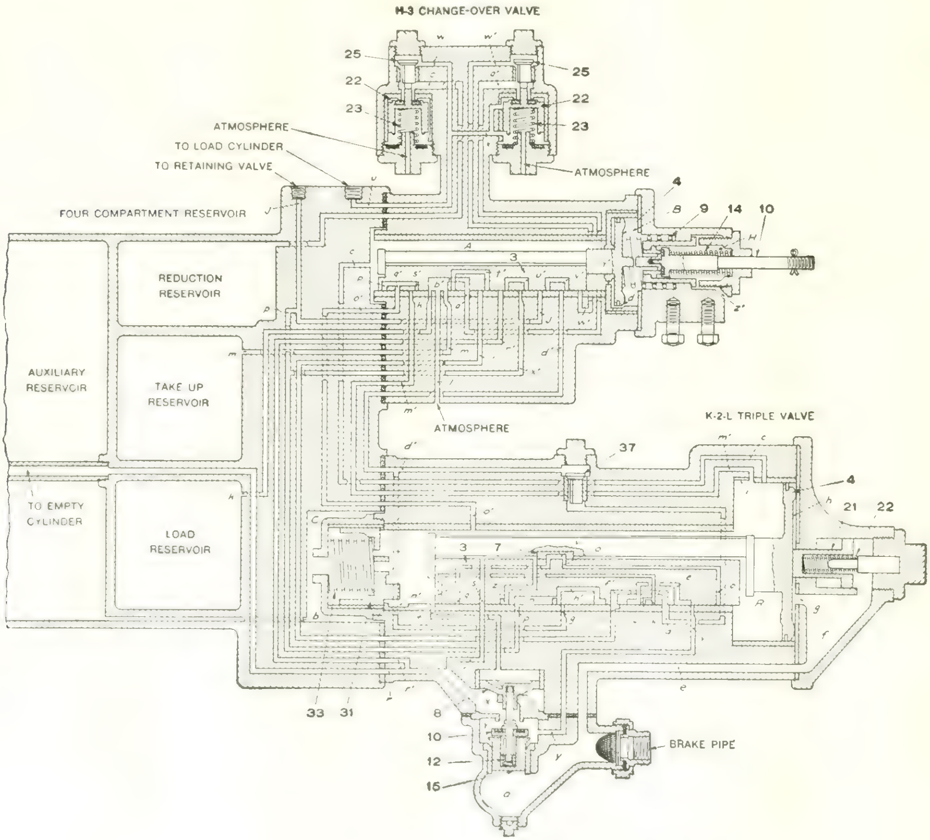
[illegible] the differential that is obtained between the brake pipe and auxiliary reservoir, the retarding device contains a spring under a tension that requires 3 lbs. higher brake pipe than auxiliary pressure to compress it and under ordinary conditions this may be obtained as far back as the 25th or 30th car in the train, and when this difference is attained and the triple valve is forced to retarded release position, in which a smaller exhaust cavity in the slide valve is utilized where the pressure cannot be sufficiently increased to move the valves to retard release position, the recharge will be through the standard feed groove, but at the head end the higher pressure will flow through a smaller groove, thus establishing a more uniform rate of recharge and at the same time permit of less brake pipe pressure to be absorbed by the head auxiliaries, thus facilitating a more prompt recharge of rear brakes. When auxiliary and brake pipe are nearly equal the retarding spring will return the triple piston to normal release.

and thus cause a continuation or propagation of quick action throughout the entire train in the usual manner.

In a future issue the operation of the brake when in load position, or when the second cylinder is used to provide a braking force to correspond with the load, will be explained and additional diagrammatic views will be shown.

Dirty Triple Valves.

The expression "dirty triple valve," has



[illegible]

[illegible] time, the back of the triple piston is forced [illegible] air-tight joint with the exception of one [illegible] standard feed groove is used, so that the rate of auxiliary reservoir recharge will be slower than otherwise to the intent [illegible] uniform, that is, at the rear of the train, ing spring will return the triple piston to normal release.

Emergency, or quick action, is caused by a sudden and considerable reduction in the brake pipe pressure, or if the rate of brake pipe reduction exceeds the capacity of the service port to expand auxiliary reservoir pressure into the brake cylinder sufficiently to compress the graduating spring, the triple piston will travel its full stroke and move the slide valve to a position [illegible] open the brake pipe to the brake cylinder.

[illegible] admitted as an [illegible] nomenclature practically since the inception of the device itself, and has been, and is still being, used to account for a multitude of air brake disorders.

At the present time, however, when every large railroad system is making a strenuous effort to maintain an accurate check upon, and record of, the performance of every individual car brake, this expression should be forgotten in making a report of the condition of a brake.

The report of a triple valve test should

state just what rack test or tests the valve failed to pass, for obviously the valve is either O K or it fails in some specific operation, and this is the information that is desired, then in the event of an actual case of failure to release or the development of undesired quick action, and no failure found by the test rack, a fair estimate may be formed of the part contributed by adverse weather conditions or of the introduction of outside elements.

If, as an example, a valve undergoing a test fails to pass the service sensitiveness or the friction release test, and upon examination it is found to have a deposit of dirt or gummy substance upon the slide valve face, slide valve seat, on the piston ring, or in the piston bushing, which after being removed, and without making any change in slide valve spring tension or polishing any surfaces, permits the valve to then pass a satisfactory test, it is permissible to designate the disorder as emanating from a "dirty triple valve," but the presence of foreign matter that does not interfere with the correct operation of the valve should be ignored, and to call attention to it merely constitutes a misleading report, and as a general proposition, gives no actual information.

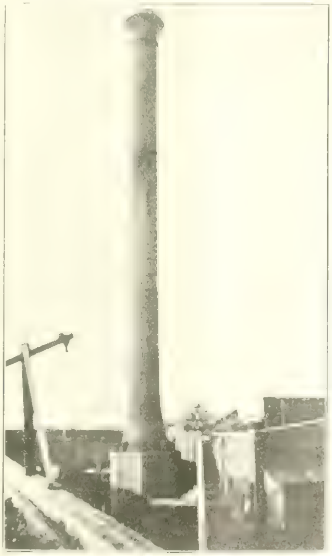
We do not intend to infer that a triple valve that passes the prescribed test is absolutely correct from a mechanical point of view, but it does insure that the operation is satisfactory under the particular conditions existing at the time of test, so while the test rack may serve as a check upon inferior workmanship and establish limits of wear, it cannot be expected to compensate for a lack of intelligence upon the part of the operator, or to anticipate certain adverse conditions that may be met in train service.

What we have in mind in connection with foreign substance is a triple valve with a piston from 3/64 inch to 1/16 inch smaller than the inside diameter of the bushing, which, with a neatly fitted ring, will pass the ring leakage test, but a small quantity of foreign matter lodging in the bushing and piston groove will usually result in a stuck brake or slid flat wheels on account of ring leakage, which the test rack will then show, but if the foreign matter is removed, the valve will again pass the test and the valve again goes into service to repeat the performance while the report shows disorder to be due to a dirty triple valve, and conversely, a triple valve with a neatly fitted piston under the same conditions may run successfully to the cleaning period and pass the ring leakage test, even with a packing ring that is stuck fast in the piston groove.

Experienced air brake men are not so easily misled concerning reports of tests, in fact they are inclined to regard the dirty triple valve report as an admission of failure to locate any disorder, or as an attempt to cover up some mechanical defect, but such reports are frequently taken at their face value by heads of departments who have no time to devote to technical details, with the result that the inaccurate reports sometimes create a very unfavorable impression.

Cutting Down a Smoke-Stack.

At the North Springfield shops of the St. Louis & San Francisco Railroad, a clever piece of work was done last month by removing a part of the smoke stack at the stationary boilers. The height of the stack was 146 feet. There were seventeen rings removed from the top, each ring measuring nearly 5 feet in height. The cutting was done by the Oxy-Acteylene method, making quite a saving in time and material. The accompanying illustrations show views of the stack before beginning the job, and after various parts were removed. The trestle was on the inside, and each ring was removed after being cut into three sections.



SMOKE STACK, SHOPS OF [illegible] SAN FRANCISCO [illegible]

[illegible] OXY-ACETYLENE METHOD.

Give Praise When Due.

[illegible] that the harsh word was the best method of keeping men up to the work. He has obtained a change of heart lately and gave expression to the following sentiments:

"I used to think that no man ought ever be praised, that it was up to every man to do his duty and to work to the best of his ability without praise or coddling, but I think now that occasionally when a man has done a good thing it does no harm to pat him on the back a little.

'You have to use discrimination about this, I will admit. There are men who if you praise them get a swelled head, throw out their chests and think they are the whole works and straightway begin to deteriorate or to require praise all the time, but there's an astonishing number of men of quite another sort.

"I know lots of men who work not only faithfully but well, men devoted to duty who take a pride in what they do whatever it may be and who think of that only, never looking for praise; but, like the rest of us, they are still human. And now suppose some day such a man pulls off a job that is really a little better than his daily work?

'Why, what I feel like doing and what I do now is to say to him, 'Billy, it was a good thing,' and I find it does no harm, but on the contrary I used to think that [illegible] that if he didn't he was a poor sort, and as far as that's concerned, I think that way now, but now I think a little praise now and then does no harm, and it may be for the man that gets it a source of very great comfort and pleasure."

Marking Paint.

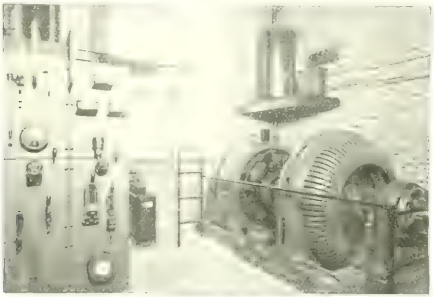
In marking parts of machinery in repair shops for identification in reassembling, and where it is not always convenient to do so with steel dies, a paint of white lead mixed with turpentine to a thin consistency may be used. It dries quickly and is not easily removed. The parts to be marked should be cleaned with kerosene oil before applying the marking solu-

It may be added that in renewing the markings kerosene oil is an excellent to their complete renewal.

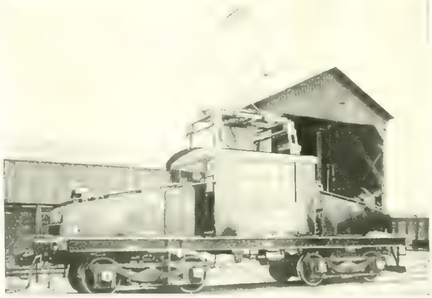
Electrical Department

General Electric Company's 1500-Volt Substation Equipment on the Chicago, Milwaukee & St. Paul Railroad

As [illegible] the 3,000-volt main line electrification, the Chicago, Milwaukee & St. Paul Railway has recently begun electrical operation of the terminal line in the city of Great Falls, Mont. This city is at present the terminal of the new 138-mile feeder line from Lewistown, Mont., connecting with the main line transcontinental division at Harlowton, the eastern terminus of the 3,000-volt electrification now under construction. The Great Falls terminal yards are located in the center of the city and are connected by a crosstown line, about 4 miles in length, known as the Valeria Way Line. There are about 3 miles of additional electrified trackage, making a total of 7 miles. The terminal buildings include a large freight house, roundhouse, power plant and passenger station.



[illegible] EQUIPMENT



[illegible] ELECTRIC LOCOMOTIVE

[illegible] yards and the terminal yard pass through the business part of the city; and it is expected that considerable benefit will be derived from the elimination of steam locomotive smoke from the center of the city, as well as a reduction in the cost of train haulage. The traffic includes the transfer of both freight and passenger trains from the fall yards to the terminal station, as well as switching service in the terminals.

The electrical equipment is of sufficient [illegible] trains operating at about [illegible] m. p. hr. on the maximum grades of 0.65 per cent. Electric power is supplied by the Great Falls Power Company from the hydro-electric plant at Rainbow Falls, about 6 miles from the substation. Energy is [illegible] les, as generated at the power station.

The substation equipment is located in the power station operated by the rail[illegible] company for [illegible] the terminal buildings, and includes a 2-unit, synchronous motor-generator set with a two-panel switchboard for controlling the alternating and direct-current units. The motor is rated 435 kv-a (0.8 power factor [illegible]) of carrying 200 per cent. overload, or 900 r. p. m. Provision is made for starting as an induction motor through a compensator, which is operated from the alternating current panel. The generator is of the commutating pole type, rated 300 kw. at 1,500 volts. The set is capable of carrying 200 per cent. overland, or 900 kw. momentarily. Excitation for the a-c motor fields and for the shunt fields of the d-c generator is furnished by a 10-kw., 125 volt, direct-connected exciter. The switchboard consists of two natural black slate panels, one controlling the synchronous motor and the other the direct-current generator and feeder. The d-c panel is a standard 1,500-volt type, carrying remote control, hand-operated switch and circuit breaker mounted between slate barriers at the top of the panel. The motor panel contains the usual instruments and starting and operating switches for controlling the motor. An aluminum cell lightning arrester is also installed in the station as a protection against electrical storms.

All trains are handled by a standard, 50-ton electric locomotive of the steeple cab type, designed for slow speed freight and switching service. The running gear consists of two swivel equalized trucks, carried on semi-elliptic equalizer springs. The driving wheels are of solid rolled steel, 36-in. diameter. The motor equipment includes four GE-207, 750-volt, box-frame, commutating pole motors insulated for 1,500 volts. Each motor has a normal one-hour rating [illegible] hp. at 750 volts, and two motors are connected permanently in series. All motors are ventilated by a blower direct-connected to the dynamotor in the cab of the locomotive. The gear reduction is 64/17. The control equipment is Sprague General Electric Type M, arranged for operation from either end of the cab. There are 10 steps with the motors in series and 7 steps in series-parallel. Control current for operating the contractors, lighting and other auxiliary circuits is furnished by a Type CDM-19, 1,500/600-volt dynamotor. A multivane fan carried on an extension of the shaft furnishes air for ventilating the motors.

The current collector is a sliding pantograph, similar to that being installed on the main line 3,000-volt locomotives. The slider is lifted into position by air pressure and is held against the wire by steel coil springs. Provision is made for operating at trolley heights varying from 17 to 25½ ft. above the top of the rail.

Compressed air for operating the air brakes, whistles and sanders is supplied by two CP-29, 1,500-volt, motor-driven air compressors. Each of these units has a displacement of 27 cu. ft. of air per minute at 90 lbs. pressure. The compressors are located in the cab of the locomotive, convenient for inspection. A headlight, provided with a concentrated filament type Mazda lamp of about 100 c.-p., is mounted on each end of the locomotive. As a safety precaution, no trolley wire is installed inside of the roundhouse. A connection is made in the cab of the locomotive for applying power to the locomotive through a length of special flexible cable insulated for 2,400 volts. A double-throw switch in the lo-

comotive cab allows connection to be made either to the trolley or cable circuit.

The overhead line construction is of the catenary type, similar in a general way to that installed on the Butte, Anaconda & Pacific 2,400-volt railroad. Both span and bracket construction are used, depending on local conditions. Poles are spaced approximately 150 ft. apart on tangent track, supporting a 4/0 grooved trolley from a 3-point suspension. There is no feeder copper installed. The work was done by the electrification department of the Chicago, Milwaukee & St. Paul Railroad, R. Beeuwkes, engineer-in-charge, under direction of C. A. Goodnow, assistant to the president. All of the electrical apparatus, including locomotive, substation equipment and line material, was furnished by the General Electric Company.

Westinghouse Electric & Manufacturing.

The Westinghouse Electric & Manufacturing Company reports the following orders among those recently received: Scranton, Binghampton Railroad Company, Scranton, Pa., for one 400-kw., 600-volt, d. c., 6-phase, 26-cycle, 750-r. p. m., compound wound, a. c. self-starting rotary converter; three 150-k. v. a., 370-volt, high-tension to rotary voltage low-tension, single-phase, 25-cycle oil-insulated, self-cooled transformers; and one 2-panel switchboard. Pacific Electric Railway Company, Los Angeles, Cal., for one 1,000-k. w., 600-volt d. c. 15,000-volt a. c., three-phase 60-cycle, 750-r. p. m., compensated wound, direct-current generator; synchronous, motor generator set. Oklahoma Railways Company, Oklahoma City, Okla., eight double No. 306-V motor equipments with type K-35 control.

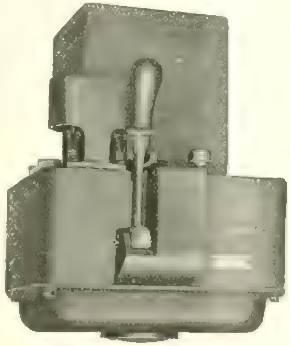
Improved Industrial Type Oil Switch.

This improved type of oil switch is used extensively in industrial establishments to control and protect induction motors up to 2,500 volts and 300 amperes. It can be mounted on a wall, post or other vertical flat surface, or by means of suitable supports on the machine operated by the motor. The switch is made by the General Electric Company in both non-automatic and automatic forms; the first simply to start and stop the motor, and the second to cut off current from the motor automatically on the occurrence of an overload greater than that for which the overload trip is set.

Through a recent improvement in the design of the mechanism, a low-voltage trip can be added to the automatic switch as an attachment at any time. To the non-automatic switch, either a low-voltage trip or a series-overload trip, or both, can be added whenever desired. Both means of tripping are mounted inside the switch cover.

Up to 550 volts (except on 110 volts, 60 cycle circuits, where the trip coil only is sufficient), an auto-transformer is used in place of the resistance previously required in series with the low-voltage tripping coil. This transformer has taps to which proper connections can be made for the operating voltage. For 2,200 volt circuits, a new type voltage transformer replaces the transformer and series resistance used heretofore. The use of the new auto-transformer, or voltage transformer, makes the watt loss in the low-voltage device practically negligible.

On the switch with the time limit-overload trip, the calibrating tubes and dash pots are protected from injury by a cast



IMPROVED OIL SWITCH

iron guard which has been added to the equipment.

Switches can also be furnished with covers arranged to mount a round pattern ammeter and provide, in addition to control and protection, a means of knowing at all times the amount of current being taken by the motor. This gives a continual indication of the motor load and the opportunity to detect trouble in the motor or its circuit.

Nickel Plating.

To make the nickel-plating solution take as many as 12 oz. of crystals of ammonio-sulphate of nickel as you wish to make up gallons of bath. Now bring some clean water up to the boiling point, and pour sufficient on the crystals to just dissolve them. When cold, filter to remove any mechanical impurities; then add cold water to make up the desired number of gallons. If properly made up, the sp.gr. of the solution should be 1.52. It should be as nearly neutral to test paper as possible; if alkaline, the deposit is dark in color; if acid, it tends to peel off. The objects to be plated must be thoroughly cleaned and buffed up in the usual way, and plunged directly after being rinsed from the potash bath into the nickelling vat, in which are suspended on the positive side nickel anodes of a size proportionate to the surface to be covered. The articles to be plated are attached to the negative lead of the dynamo or other source of electricity. The current is to be turned on before the work is immersed in the solution. The amount of current (in amperes) will be dependent on the size of objects to be coated, and must be regulated by a resistance board. The pressure should be about 6 volts at the start, but not exceed 3 or 4 as soon as a film has formed.

The South in the Lead Again.

A hidden want is being gratified in the South by marking points of interest, particularly scenes of battles, army and brigade headquarters, and the names of principal streams along its lines are being marked by the Nashville, Chattanooga & St. Louis Railway, so that the traveler may easily see from the car windows the sites of some of the most prominent engagements of the Civil war. The markers are cast in metal and mounted on railroad rails, set in concrete. The tablets are painted white, and the black lettering makes the marker easily discernable.

The new work has a particular appeal to those who fought in the war of the States, and to their descendants a trip through the South will now have an added interest, for they can observe the sites of the battles of which they have heard their father or grandfather talk. The thoughtfulness of the management of the road in establishing these markers has been the subject of much favorable comment.

An Old One by Mark Twain.

When Mark Twain in his early days was editor of a Missouri paper, a superstitious subscriber wrote him saying that he had found a spider in his paper, and asking him whether that was a sign of good or bad luck. The humorist wrote him this answer and printed it:

"Old Subscriber: Finding a spider in your paper was neither good luck nor bad luck for you. The spider was merely looking over our paper to see which merchant is not advertising, so that he can go to that store, spin his web across the door and lead a life of undisturbed peace ever afterwards."

Mr. F. K. Irvin, formerly with the New York, New Haven & Hartford, has become connected with the Chicago office [illegible] will have charge of the railroad machine [illegible] business in that territory. Mr. D. S. Woods, formerly Philadelphia sales- [illegible] has been transferred to New York.

New Type of All-Steel Passenger Cars for the Erie

May Be Used for Electrification if Desired

The Pressed Steel Car Company, Pittsburgh, Pa., has recently completed the [illegible] cars of all-steel construction for the Erie railroad. There are seven coaches and one combination baggage and smoking car. [illegible] Mr. L. B.

NEW TYPE OF ALL-STEEL PASSENGER CARS FOR THE ERIE RAILROAD.

Stilwell, consulting engineer, 100 Broadway, New York. The general construction of the cars is similar to that of the New York, Westchester & Boston electric suburban cars, and they are so constructed that while at present they are adapted for steam operation, they are also ready for

[illegible]

electric equipment as soon as [illegible] change may be deemed desirable.

[illegible] fact that they are lighter in weight than [illegible] passenger cars that have a much lesser seating capacity. The cars are 70 feet 4 inches in length and the total weight is 95,400 pounds. The light weight has been secured by the absence of all unnecessary heavy bracing. The cars are fitted with a friction draft gear and buffing device of sufficient capacity to absorb all shocks that may be received in regular service. The roof structure is formed of pressed channel carlines, and is of the compound arched type. The chief point aimed at in this form of construction has been the possibility of resisting shocks that may be encountered in service. As is well known the floor framing has always re- [illegible] providing [illegible] suitable structure for draft [illegible] momentum. When such accidents occured the roof usually fell to pieces at the slightest impact while the floor remained fairly firm, the feet of the passengers being thus well protected while their heads were allowed to take such chances as were incidental to the falling of the flimsy work overhead. In the new cars the rigidity of the roof construction fairly matches that of the floor and it is no idle boast to state that for the first time the heads of the passengers are protected from anything short of a collision of the most stupendous kind.

The trucks also present new features, being furnished with long elliptic springs under the bolsters, and also with coil journal box springs. The dimensions and adjustment are such that the easy riding qualities of the car are particularly evident to all.

Construction of French-Abyssinian Railroad.

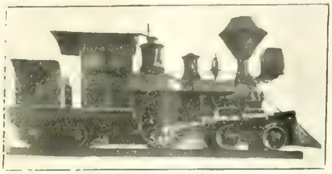
In 1897 work was begun on the French-Abyssinian railroad, and after many vicissitudes, necessitating the aid of a subsidy by the French government, the first section of the road reached the town of Dire Dawa, a distance of 187 miles, in the year 1903. There followed a period of inactivity due to political and financial difficulties. The old company was liquidated and a new one, entirely French, entitled La Compagnie du Chemin de Fer Franco-Ethiopian de Jibuti a Adis Ababa, began in 1909 the second section of the road, completing the same on December 11, 1913, a further distance of 144 miles. From this point, called Hawash, to Adis Ababa, there remains 156 miles, and over half the distance had been completed by the last of July, 1914. Since then construction work has been pushed forward slowly, so that on March 1, 1915, the line ended within 25 miles of Adis Ababa. The railroad when fully equipped will represent an investment of $20,000,000.

Origin and Development of Transportation

By DR. ANGUS SINCLAIR

What was known as "Transportation Day" was a very important event at the Panama-Pacific Exposition. A multitude of people assembled to honor the occasion and to listen to addresses delivered by several prominent persons. At the request of President Moore, Dr. Angus Sinclair agreed to deliver an address on the "Origin and Development of Transportation." Dr. Sinclair spoke as follows:

The severing of two continents and the joining of two oceans by the excavation of the Panama Canal was an unparalleled engineering achievement; the organizing and building the Panama-Pacific International Exposition has been a feat worthy of the event it commemorates." Westward the trend of Empire makes its way "and no step equal in magnitude to the Panama-Pacific Exposition ever before marked the advance of civilization from the East to the West.



LOCOMOTIVE, "C. P. HUNTINGTON"; SOUTHERN PACIFIC RAILWAY.

When we use the expression Empire we naturally associate the word with power begotten of violence and bloodshed, but the events culminating in the Panama-Pacific International Exposition have been triumphs of peaceful industry. In this great event we witness, brought together from remote regions of the earth, an immense variety of products, the results of highly developed skill, persistent industry, artistic ability and undaunted endeavor. The whole exhibition is an impressive sermon, proving that peace has its triumphs more renowned than war.

The attractions of the exposition as seen in the products of every nation and of every clime, besides bringing credit and glory to the producers, reflect the highest admiration on the mass of people who have so successfully worked out the different problems of transportation that have brought the ends of the earth into intimate contact.

When we study the pages of remote human history and examine the difficulties met with by mankind in the march of progress we realize that the means of moving people and produce from place to place must have proved stupendously difficult and acted as an unreleasing brake upon the advancement of civilization. Races grew and multiplied, nations were formed and entered into strife with each other. The need for expansion was ever present, but only human locomotion was available and invention was slow to provide better methods. Some courageous persons ventured upon the water on pieces of floating wood and the elements of navigation were put into operation. The ox and the horse were tamed and trained to carry burdens, but still the world moved at a painfully slow pace. Roads were not, and many centuries of semi-progress elapsed before civilized people proceeded to construct proper highways. Rome gave the world valuable lessons in road building which paved the way by slow degrees to the modern railway.

From the fall of the Roman Empire the student in search of convenient highways follows a long dreary journey through the mires of ignorance and prejudice until he finds coal miners in Great Britain and other movers of heavy material putting down rails of iron to take the place of soft yielding highways in which the wheels of heavily loaded vehicles sank to their axles. The crude coal pit tramways pointed the way to superior means of land transportation and by degrees paved the way to the introduction of steam railways.

The highways which the Romans constructed were superior to the early iron tramways, but their purpose was not to increase the comfort of the people. They were intended to accelerate the movement of armies intended to take part in aggressive wars designed for the oppression of nations. It was different with the [illegible]ble tramways used in facilitating the transportation of coal. Britain is a comparatively treeless country and the people have been compelled to depend upon bituminous coal to keep their homes warm, to defy the vigorous of cold weather. The miserable highways in use added greatly to the cost of coal, and the cost of transporting the warmth giving element was in some cases becoming prohibitive when the iron tramway stepped in to renew the comforts of the people's homes. Thus from the beginning the iron road has been the means of promoting public comfort, and the development of these crude tramways into the magnificent railways whose services we now enjoy has carried the benefits in full measure to all classes in every country served by railroads.

The starting of the first steam locomotive to engage in general train service is within the memory of men still living. In what followed they have seen the greatest industrial revolution the world has ever experienced. The speaker has witnessed most of the changes that have accompanied railway operation, and there is no question that they have been highly beneficial to nearly all classes in every country traversed by the iron rail. They have raised workmen to a higher level than they ever reached before and rendered the conditions of life much more endurable than it ever was in the occupations pursued before the iron horse made its appearance.

My memory goes back to the time when certain pioneer railways in Scotland were organizing their working forces. The lack of facilities of transportation frequently left a scarcity of workmen in one region while men were idle in others. One of the principal railway men is the station master, who must have the willing hands of a laborer and the clerical knowledge of an accountant. It might have been expected that such a personage would be difficult to find, but the demand brought out the man. Among old world workmen the hand loom weaver was long noted for intelligence and practical knowledge. He was also the worst paid skilled workman in the country. This class of laborer readily deserted the loom for better paid occupations. On the railway where my first work was done about 85 per cent. of the station masters had been weavers and a large proportion of trainmen, trackmen and others had originally driven the shuttle. In the good old times the Highlands of Scotland were crowded with idle men ready to follow the drum, but lacked the

MALLET COMPOUND [illegible]

[illegible] The men readily deserted the mountains when they learned that men were in demand to help railway building and they proved excel- [illegible] line of work they learned to perform.

The weavers were a peculiar class and carried into railway life some habits that had to be relinquished. Habits that are not absolutely objectionable in some occupations must not be tolerated in railway men, but it took sad experience to demonstrate that truth. So long as a man said his prayers and went to church regularly he was not looked down upon for getting drunk occasionally. That is all changed nowadays and the least lapse from sobriety is certain to bring severe punishment. In that way railway operation has exacted a strong moral influence, not only in Scotland but in every country where drinking habits have prevailed.

I began my engineering experience in the office of the locomotive superintendent of a Scottish railway. One day while I was there an engine driver named Harry McLennan came into the office and asked, "Did you wish to see me, Mr. Yarrow?"

"That I did, Harry," replied the superintendent, "you were so drunk when you went to take out your train last Monday that they had to send for another driver. That will not do for passenger trains. If it happens again I shall have to put you back to goods trains." That driver was the grandfather and namesake of Harry Lauder, the celebrated Scots entertainer.

Jamie Petrie was agent at one of our stations and was considered a good man, but he had a lapse occasionally. In his zeal to be an up-to-date railway man, Jamie had been at a Burns' festival and although he said his prayers regularly, he was also fond of a dram. One night [illegible] took his share of the toddy. He tried to [illegible] three in the morning, but was detected making some strange noises.

"Is that you Jamie," said the wife, "is there anything the matter wi' you? Are you no feeling weel?"

"Aye, I feel fine, but I canna mind a damned word o' my prayers."

European countries inaugurated the construction of railways, but the United States lost no time in adopting the invention to facilitate transport that the steam engine made possible. The first movement in this direction was arrived at connecting Western settlements with the towns and harbors on the Atlantic seaboard.

PART OF WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY'S EXHIBIT.

There were greater opportunities for improving the condition of the people of the United States by the construction of railways than there was in any other country. A vast area of fertile land was waiting cultivation, immense forests of valuable timber were wasting for want of the woodman's axe and the marvel producing saw mill; but these remained idle for want of facilities necessary to carry the products to the markets of the world.

When the construction of the Baltimore & Ohio Railroad was begun there were no highways in the country capable of holding up a vehicle containing two tons of produce, so the people depended upon waterways as mediums of transportation. That influenced the location of the people, and sparse settlements were effected near rivers and ocean estuaries; but the growth of population was necessarily slow. The public spirited leaders of the country quickly perceived the immense possibilities of railroad construction, and enterprises of that character were pushed forward with amazing rapidity, considering the scarcity of superfluous capital. Within a few years pathless prairies and dense forests that had previously been the haunts of savage animals and ferocious human beings were converted into smiling fruitful fields nurturing happy homes, all by the influence of the iron highway.

The providing of the skilled workmen to build and care for the railroad machinery was a problem solved in a way that reflected the greatest credit upon he ingenuity of Americans. When Peter Cooper had his Tom Thumb locomotive built in Baltimore, there were no construction mechanics in the country except watchmakers, carpenters and blacksmiths; yet people following these callings readily developed into machinists and engineers. And some of these men who had acquired skill under extreme difficulties developed into mechanical engineers of world-wide fame.

PART OF THE GENERAL ELECTRIC COMPANY'S EXHIBIT

Circumstances made the American farmer something of a mechanic, for he frequently had to do blacksmithing on his own implements and to construct and repair his own buildings. When he had a bent in that direction he was ready to lend his skill in other lines of industry. When

the Master Car Builders decided to adopt a certain type of car coupler, many patents for improved couplers were secured by farmers. For some time railroad mechanical officials were burdened by the applications of farmers and others to examine car couplers that had just been patented. To relieve himself of this burden a prominent superintendent of motive power began sending patentees to me, saying that if Augus Sinclair reported favorably he would examine the inventions. One day a big lanky person carry- a black bag entered my office and remarked that he had a little invention that Mr. Buchanan told him to show to me. Another car coupler was my thought. "Take it out and put it together upon the floor," I said to the man.

He took from the bag a variety of pieces evidently worked out by a jack knife and proceeded to string them together. I gazed at the structure with the idea that it was intended to hold two cars together, but failed to find the connecting mechanism.

Well, my good man, I finally exclaimed, I have examined a great many car couplers, but that is the most extraordinary car coupler I have ever seen. He looked up with an innocent smile and said: "That is not a car coupler, it's a potato digger." I did not profess to be an expert on potato diggers.

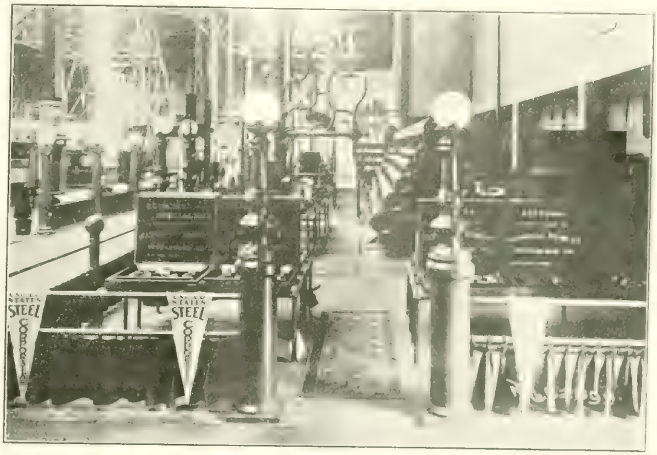
Wherever railways have been built and put into operation they have conferred permanent benefits upon the people and they have been usually appreciated and treated accordingly, but an exception to this must be taken to some portions of the United States. It has become the fashion in some quarters to treat railroad property as if it possessed no rights the people were bound to respect. Even government bureaus have kept heaping burdens upon railroads without compensation. Unless this sentiment changes the railroad companies will soon be unable to render the people the services they are entitled to receive. It is a very sad condition when any loose mouthed politician can attain popularity by abusing railroads.

Anti-railroad sentiment is peculiarly undeserved in the United States for our railroads have always transported people and freight at lower rates than those charged in other countries, and the managers are working ceaselessly to lower the cost of moving trains. Powerful locomotive and large capacity cars keep reducing operating expenses, but these do not leave a margin of profit sufficient to make railroad investment profitable. The poet Burns in an ode to the devil expressed the hope that his Satannic Majesty might take a thought and mend his ways. I conclude by expressing the hope that the enemies of railroads will soon begin to pour their venom into holes that will be less harmful to the great mass of the people at large.

National Tube Company's Exhibit

A very interesting section of the exhibit of the United States Steel Corporation's exhibit at the Panama-Pacific Exposition is that of the National Tube Company, which occupies an area of approximately 6,000 square feet. This company manufactures three closely related, and yet distinctly different, lines of products, and their exhibit naturally divides itself into the following sections: "National" pipe and allied tubular products, "Kewanee" specialties, fittings, etc., "Shelby" seamless tubing and cylinders. The display of "National" pipe and allied products is the largest of the three sections. This is as it should be, as the National Tube Company has an annual capacity exceeding 1,250,000 tons of tubular products.

Entering the main section, the visitor walks through a large arch, fifteen feet in height, and made of miscellaneous bends of 4-inch "National" pipe. Immediately behind this is a massive rack, on which are displayed the various types of "National" pipe used in the oil fields of the world. Capping this enormous rack, is the largest and longest individual length of lap-welded wrought pipe ever made in America, consisting of one length [illegible] feet 6 inches long. This "double" length of "National" pipe, was welded at the National Works of National Tube Company, McKeesport, Pa.



NATIONAL TUBE COMPANY EXHIBIT [illegible]

On the right hand there is an extensive display of "Kewanee" specialties, including unions, regrinding valve, brass fittings, cocks and valves, malleable and cast iron and wrought fittings, testing machines, and other devices.

A Consistent Mason.

Engineer F. E. Mason, was on Erie Railroad 3-77 May 20, and when passing Matthews Crossing, just west of Leavittsburg, Ohio, he discovered a house on fire. He stopped his train, and he and his fireman and brakeman, went over to the house and notified the people it was on fire. The old gentleman was in the barn milking the cows and his wife was in bed.

Engineer Mason and his two fellow workers put the fire out. Train delayed about 15 minutes. They were running 3 hours 50 minutes late, and he caught his time at "FM" Tower.

[illegible] have the thanks of the company for performing such a humane act.—*Erie Magazine.*

Dr. Willard A. Smith.

Dr. Willard A. Smith, president and general manager of the *Railway Review*, was a member of the Jury of Awards of the Transportation Department of the Panama-Pacific Exposition and displayed very intimate knowledge concerning the merits of the various exhibits. Dr. Smith has filled official positions connected with a variety of important exhibitions. In connection with such work various honors have been conferred upon him.

He is an officer of the Legion of Honor of France; Knight of the Royal Order [illegible]

Items of Personal Interest

[illegible] has been appointed [illegible], with office at Billings, Mont.

Mr. O. C. Campbell has been appointed road foreman of engines of the Southern with office at Selma, Ala.

[illegible] appointed master mechanic of the Norfolk Southern with office at Raleigh, N. C.

Mr. G. Feetham has been appointed acting roundhouse foreman of the Intercolonial, with offices at Truro, N. S.

Mr. C. A. Halleen has been appointed general foreman of the New York Central, with office at Ashtabula, Ohio.

Mr. A. H. Eagar has been appointed superintendent of shops of the Canadian [illegible] Winnipeg, Man.

[illegible] has been appointed master mechanic of the Fort Smith & Western, with office at Fort Smith, Ark.

Mr. T. M. O'Connor has been appointed roundhouse foreman of the Minneapolis & St. Louis, with office at Fort Dodge, Iowa.

Mr. R. M. Westbrook has been appointed general foreman of the Chicago & Eastern Illinois, with office at West Frankfort, Ill.

Mr. L. Chapman has been appointed assistant master mechanic of the Chicago & North Western with office at Belle Plaine, Iowa.

Mr. M. R. McDaniel has been appointed master mechanic of the Central Indiana with office at Muncie, Ind., succeeding Mr. J. Cullinan.

[illegible] road foreman of engines of the Southern with offices at Spencer, N. C., succeeding Mr. H. J. Heily.

Mr. N. R. Ross has been appointed en-[illegible] with office at St. Paul, Minn., succeeding Mr. W. R. Wood.

Mr. J. A. Walton has been appointed [illegible] at London, Ont., succeeding Mr. J. R. Leckie, promoted.

[illegible] son, with office at Colonie, N. Y., succeeding Mr. A. Marters.

[illegible]

car foreman of the Chicago, Milwaukee & St. Paul, with office at Tacoma, Wash., succeeding Mr. W. P. James.

Mr. R. S. Maurice has been appointed general foreman of car repairs of the Erie, with office at Jersey City, N. J., succeeding Mr. P. Fox, deceased.

Mr. A. M. Joiner has been appointed master mechanic of the Hawkinsville & Western with office at Hawkinsville, Ga., succeeding Mr. E. H. Brantley.

Mr. J. B. Halladay has been appointed roundhouse foreman of the Minneapolis & St. Louis, with office at Marshalltown, Iowa, succeeding Mr. J. P. Walsh.

Mr. W. I. Peters has been appointed foreman of locomotive repairs of the Chicago, St. Paul, Minneapolis & Omaha, with office at Worthington, Minn.

Mr. W. H. Eddy has been appointed general foreman of the motive power department of the Delaware, Lackawana & Western, with office at Syracuse, N. Y.

Mr. C. T. Ripley, formerly assistant engineer of tests on the Santa Fe, has been appointed general mechanical inspector on the same road with office at Chicago, Ill.

Mr. N. P. Cosgrove has been appointed road foreman of equipment of the Chicago, Rock Island & Pacific with office at Goodland, Kan., succeeding Mr. J. L. Boyle.

Mr. Lewis L. Collier has been appointed master mechanic of the Pacific & Idaho Northern with office at New Meadows, Idaho, succeeding Mr. L. L. McCowan.

Mr. T. C. O'Brien, formerly general boiler inspector of the Cincinnati, Hamilton & Dayton, has been appointed general foreman on the same road, with office at Lima, Ohio.

Mr. J. O. Southworth has been appointed master mechanic of the Blytheville, Louisiana & Arkansas Southern with office at Blytheville, Ark., succeeding Mr. D. S. Kysor.

Mr. W. Hope, formerly erecting shop foreman of the Canadian Northern at Joliette, Que., has been appointed foreman on the same road with offices at Limoilou, Que.

[illegible] master mechanic of the Pennsylvania Lines West of Pittsburgh, has been appointed assistant engineer of motive power, succeeding Mr. [illegible]

Mr. E. P. Howell, formerly general foreman of the erecting shop of the Atlantic Coast Line, at Waycross, Ga., has been appointed general foreman on the [illegible]

Mr. R. G. Gilbride, formerly general [illegible] Graham, Ont., has resigned to assume the managership of the newly formed Spartan Machine Company, Montreal.

[illegible] has been appointed senior inspector of motive power for the eastern district, in the division of valuation, Interstate Commerce Commission, with headquarters at Washington, D. C.

Mr. M. B. McPartland has been appointed master mechanic of the Colorado division of the Chicago, Rock Island and Pacific with office at Goodland, Kan., succeeding Mr. E. F. Tegtmeyer, resigned.

Mr. J. L. Curry, formerly road foreman of equipment of the Chicago, Rock Island & Pacific, has been appointed supervisor of locomotive operation on the same road, with office at El Reno, Okla.

Mr. Oscar Stevens, formerly road foreman of engines on the Baltimore & Ohio Southwestern, has been appointed to a similar position on the Toledo division of the same road with headquarters at Lima, Ohio.

Mr. M. F. Smith, formerly general car and locomotive foreman on the Chicago, Milwaukee & St. Paul, has been promoted to district master mechanic, with office at Dubuque, Iowa, succeeding Mr. E. Z. Hermanrader.

Mr. L. A. Hardin, formerly general foreman on the Chicago & North Western, has been appointed assistant master mechanic on the same road with office at So. Pekin, Ill., succeeding Mr. L. Chapman, promoted.

Mr. W. H. Keller, formerly assistant master mechanic of the Baltimore Southwestern at Cincinnati, Ohio, has been appointed master mechanic of the Indiana division of the same road, with offices at Cincinnati, Ohio.

Mr. F. P. Miller, formerly general foreman of the locomotive department of the Chicago, Milwaukee & St. Paul, has been appointed general foreman of the locomotive department of the same road, with office at Marion, Iowa.

Mr. B. B. Milner has been appointed engineer of motive power of the New York Central, in charge of locomotive design and construction and the relation of locomotive standards to operation with office at New York.

Mr. Thomas Wardle has been appointed master mechanic of the Denver & Salt Lake River with office at Tabernash, Colo. Mr. Wardle was formerly master mechanic of the International & Great Northern, at Palestine, Tex.

Mr. R. W. Brown, formerly road foreman of engines on the Toledo division of the Cincinnati, Hamilton & Dayton, has been appointed trainmaster of the Wilston and Delphos division of the same road, with headquarters at Dayton, Ohio.

Mr. G. E. Sisco, formerly assistant engineer of motive power of the Pennsylvania Lines West of Pittsburgh, has been appointed master mechanic [illegible] the same

road, with office at Toledo, Ohio, succeeding Mr. J. W. Hopkins, transferred.

Mr. Joseph Battles has been appointed district sales manager of the Terry Steam Turbine Company, covering the states of New Mexico, Colorado, Wyoming and the western part of Nebraska, with office at the National Bank Building, Denver, Colo.

Mr. John H. Hines, formerly foreman of the machine shops of the Chicago & North Western at Norfolk, Neb., has been appointed roundhouse foreman on the same road, with office at Fremont, Neb., and Mr. T. Slattery has been appointed foreman at Norfolk, succeeding Mr. Hines.

Mr. I. A. Mitchell, formerly locomotive foreman of the Grand Trunk Pacific, at Biggar, Sask., has been appointed general foreman at the Transcona, Man., shops on the same road, and Mr. A. McTavish, formerly locomotive inspector at Transcona, has been appointed locomotive foreman at Biggar.

Mr. T. I. Burns has been appointed superintendent of rolling stock of the Michigan Central with office at Detroit, Mich. Mr. Burns entered railway service on the Michigan Central in 1890, and has continued in various positions in the car and locomotive departments. Six years ago he was appointed assistant superintendent of motive power, which position he held till his recent appointment as head of the department.

Our old friend and correspondent, Mr. W. D. Holland, has been in London consulting with parties that tried to employ him to engage railroad men in America to operate the railways in Belgium. Mr. Holland is a remarkably energetic personage, with an excellent railroad acquaintance, but he failed to induce railroad men of experience in the United States to transfer their services to a European country suffering from war operations. Railroaders who agree to take service in Belgium have to be under control of the war office, which appeared to be an insurmountable obstacle.

Mr. Henry W. Miller has been elected vice-president of the Southern Railway Company, with office at Atlanta, has been announced. Mr. Miller has been in the service of the lines comprising the Southern for a period of thirty years. He began with the Richmond & Danville at his native city, Raleigh, N. C., in the capacity of a loading clerk, and during the three years following he filled various other positions in the freight offices at Raleigh. In 1888 he was appointed chief clerk and secretary to the third vice-president, and in 1890, upon the organization of the Southern, he became secretary to the second vice-president, and later was appointed to the same position under the late Col. A. B. Andrews, first vice-president. In 1910 he was made assistant to the president, at Atlanta, remaining there until his election as vice-president.

Railway Supply Manufacturers' Association

The Railway Supply Manufacturers' Association held an annual meeting at Atlantic City, N. J., on Saturday, June 12th. President J. Will Johnson, presiding. The chairman's opening address was chiefly devoted to a review of the association's work during the year, and it was

J. WILL JOHNSON
President, R. S. M. Association, 1914-15.

gratifying to learn that in spite of the continued business depression the highest degree of good feeling existed among the members and all were assured of a gradual, if not a speedy, return to better business. The slight falling off of membership was neither here or there. It was

OSCAR F. OSTBY,
[illegible]

expected, as was also the slightly diminished exhibit space as compared with some previous years. The annual reports showed a cash balance after paying all necessary expenses. The election of officers for 1915-16 resulted as follows: President, Oscar F. Ostby, Commercial Acetylene Railway Light and Signal Company; vice-president, Edmund H. Walker. Members of the executive committee: First district, J. G. Platt, Hunt-Spiller Manufacturing Corporation; second district, C. D. Eaton, American Car & Foundry Company; fourth district, John F. Schutch, Damascus Brake Beam Company; seventh district, C. B. Cass, Westinghouse Air Brake Company.

Mr. Ostby, the newly elected president, brings to the office a ripe experience in the work of the association. He has done excellent service on all of the committees and is perfectly familiar with the work of preparing exhibitions of railway supplies, and is very popular among his associates and railway officials generally.

At a meeting of the executive committee a past president's badge was presented to Mr. J. Will Johnson, the retiring president. Mr. C. B. Yardley, chairman of the badge committee, made the presentation and in a happy speech referred to the good work that Mr. Johnson had done for many years, and trusted that the association would continue to have the benefit of his large experience.

Over twelve hundred supply men were in attendance, and the exhibits were of the usually high order of excellence.

The following committees were appointed to serve during the ensuing fiscal year, 1915-16:

Hotel Committee, J. H. Kuhns, Republic Rubber Company, Chicago (chairman); P. J. Mitchell, Philip S. Justice & Company, Philadelphia, Pa.; C. D. Eaton, [illegible] York.

Finance Committee, J. C. Currie, Nathan Manufacturing Company, New York (chairman); J. F. Schutch, Damascus Brake Beam Company, Cleveland, Ohio; C. E. Postlethwaite, Pressed Steel Car Company, Pittsburgh, Pa.

Badge Committee, Edmund H. Walker, Standard Coupler Company, New York (chairman); C. B. Cass, Westinghouse Air Brake Company, St. Louis, Mo.; J. F. Schutch, Damascus Brake Beam Company, Cleveland, Ohio.

Exhibit Committee, C. B. Yardley, Jr., Lubricating Metal Company, New York (chairman); George H. Porter, Western Electric Company, Chicago; J. G. Platt, Hunt-Spiller Manufacturing Corporation. [illegible] Lighting and Power will be appointed to insure plenty of light and power.

By-laws Committee, C. E. Postlethwaite, Pressed Steel Car Company, Pittsburgh (chairman); F. E. Beal, Magnus Company, Inc., Atlanta, Ga.; C. F. Elliott, American White Lead & Color Works, Detroit, Mich.

Entertainment Committee, Gilbert E. Ryder, Locomotive Superheater Company, New York (chairman).

Enrollment Committee, Charles W. Beaver, Yale & Towne Manufacturing Company, New York (chairman).

Transportation Committee, J. L. Randolph, Economy Devices Corporation, New York (chairman).

John D. Conway has been re-elected secretary and treasurer of the association.

International Railway General Foremen's Association.

The eleventh annual convention of the International Railway General Foremen's Association will be held at the Sherman Hotel, Chicago, Ill., July 13, 14, 15, 16, 1915.

The topics for 1915 cover a wide range, and are suggestive and timely. "Valves and Valve Gearing" will be handled by Chairman Walter Smith, of the C. & N. W. Ry., and those who have followed Mr. Smith's recommendations along the lines of "Round House Efficiency" as read and discussed from his 1913 and 1914 paper on that live subject, may rest assured in the belief that no detail will be missed in this interesting subject.

Another interesting topic will be presented by Mr. A. A. Masters, of the D. & H. Ry., on "Rods, Tires, Wheels, Axles and Crank Pins." This subject will be of particular interest to the foremen attending the convention, in the handling of large power.

"Shop Efficiency," by Chairman Geo. H. Logan, of the C. & N. W. Ry., will be a spot-light topic. Railroads are looking after the pennies in these days of efficiency and economy, and it is up to the shop foremen to show why their cost of repairs is not as low as is their competitors'. Mr. Logan will tell you how.

Mr. A. B. Whitsel, of the C. & W. I. Ry., will tell the members of the General Foremen's Association everything worth knowing about operating a big round house terminal, and as Mr. Whitsel is foreman in one of the largest shops in the country, his paper will be worth going some distance to hear.

Mr. F. A. Byers, of the Frisco Lines, is chairman of one of the most wide awake topics ever handled: A subject that treats on the mechanical saving of many thousands of railroad companies' dollars by using Oxy-Acetylene welding processes. Mr. Byers is a past master in the use of [illegible] the subject without gloves.

[illegible] in point of attendance the association ever held, and judging reports from all sources, the present meeting will eclipse all others in point of attendance.

[illegible] are requested to attend and take part in [illegible] their operation, can not afford to be without representation.

Traveling Engineers.

The Twenty-third Annual Convention of the Traveling Engineers' Association will be held at the Hotel Sherman, Chicago, Ill., beginning on Tuesday, September 7, at 10 a. m., and continuing during the following three days. The subjects to be discussed embrace many of the most vital problems involved in the mechanical department of railways, and announcements in regard to the same will be made at an early date. Meanwhile the various committees are busy making arrangements to meet all the requirements of the occasion. The complaints in the past that the members did not have time enough to properly examine the exhibits will be guarded against this year, as a part of Wednesday, September 8, will be set aside to give the members an opportunity to look over and receive information in regard to the exhibits.

Rise of the Engineer of the Plug.

A San Francisco correspondent of the Iowa City *Press*, has recognized in Dr. Angus Sinclair, who delivered the principal address on Transportation Day at the Panama-Pacific Exposition, an old Iowa City personage, and has some kind words to say about him. The correspondent referred to is Mrs. Belle Gray Curtis, who was a Miss Andrews, whose father was a worthy [illegible] and an intimate friend of Dr. Sinclair, whose own [illegible] was known in Iowa City as "Engineer of the Plug."

The railroad popularly known as "The Plug" was [illegible] miles long, extending from Iowa City to Cedar Rapids [illegible] ... running the engine, between trains he attended the chemistry classes of the Iowa State University, taking up the subject most applicable to engineering [illegible]. Among favorite studies was water analysis. After a few [illegible] the Burlington, Cedar Rapids & Northern absorbed the Plug. Sinclair had been in the habit of taking water for his engine out of a creek, the road being too poor to use a well or water tank. When the change of ownership happened, the new company sent a water inspector to Iowa City to arrange for the erection of a water tank and [illegible] of a well. That district is the region of Devonian limestone and produces very hard water. This had been found out by Mr. Sinclair, who was in the habit of analyzing the water. When the water inspector explained his purpose, the engineer of the [illegible] well, and made some tests to show the hardness of the well water. The inspector then returned to Cedar Rapids and reported to the president what he had learned at Iowa City.

When President Ives heard the story, he remarked, "if that man Sinclair knows as much about water hardness as you say he does, we want him here, for hard water is the curse of this company." Accordingly another engineer was sent to relieve Mr. Sinclair, who was called to Cedar Rapids for an interview with President Ives.

When that interview took place and the president learned how a locomotive engineer came to know so much about water analysis, the matter was settled by the appointment of Mr. Sinclair to be chemist of the B. C. R. & N Railway, a position he held until allured to New York by the American Machinist Publishing Co.

Causes of Metal Corrosion.

In discussing, before the Engineers' Society of Western Pennsylvania, the protection of metal structures, Frederic H. Fay, of Fay, Spofford & Thorndike, consulting engineers, Boston, pointed out that the corrosion of metal bridges is due principally to one or more of four causes. These are exposure to locomotive gases; exposure to sea water; exposure to surface water leaking through bridge floors; overstress of the metal by which corrosion has been hastened.

The condition of frequent wetting by salt water, followed by exposure to the atmosphere, is a severe test. The Neponset bridge, built in 1877, was a small two-leaf trunnion bascule, draw span with wrought iron girders. The counterweighted ends of the girders were immersed in salt water whenever the bridge was open at high tide. These girders were painted frequently, usually with red lead, and they continued in service thirty-two years, until the bridge was rebuilt.

Laboratory experiments have shown that steel stressed beyond its elastic limit will rust more rapidly than steel, which is not overstressed. This seems to be borne out by experience in certain cases of highway bridges carrying constantly increasing street railway loads. When heavy cars have been put in service over these structures the outstanding legs of the flange or seat angles immediately under the stringers, have been found to rust very rapidly—much faster than the metal at each side of the stringer.

Lubricant for Pipe Connections.

In making pipe connections use a mixture of one pint of common machine oil with half a pint of graphite, and one quarter of a pint of white lead with one teaspoonful of emery. The emery has the effect of polishing and perfecting the fit of the threads as they are screwed together. The other ingredients make a good lubricating mixture which has sufficient consistency to prevent leaks.

DIXON'S Graphite GREASES for Railway Service

These are combinations, in exactly right proportions, of the best minerel greases with Dixon's Ticonderoga Flake Graphite, the most perfect natural lubricant in the world. The grease is a vehicle for distribution of the graphite and also has a certain lubricating value. The flake graphite, with its enduring affinity for polished metal surfaces, supplies the lasting lubricating quality lacking in even the best grease or oil. The combination, in Dixon's Graphite Greases, gives the most dependable, economical and effective lubrication that can possibly be secured—the kind of lubrication that cuts down "wearing-out power" to the limit. There is a Dixon's Graphite Grease for every railway purpose. And remember—the name "Dixon's" is the thing that counts, in graphite.

Write for "Graphite Products For The Railroad," No. 69.

Made in JERSEY CITY, N. J., by the

JOSEPH DIXON CRUCIBLE CO.

Established 18[illegible]

RAILROAD NOTES.

The Western Maryland is in the market for ten locomotives.

The Chicago Elevated Railways has placed orders for 122 steel cars with the Cincinnati Car Co.

The Southern Railway has ordered 2 Mikado type locomotives from the Baldwin Locomotive works.

The American Locomotive Co. has taken an order for small locomotive parts for the Serbian government.

The Chicago Great Western has ordered 5 switching engines from the Baldwin Locomotive Works.

The Pennsylvania has given an order to the Juniata shops to construct fifty Mikado locomotives equipped with superheaters.

The Norfolk & Southern has ordered 24 ballast cars and one parlor car from the American Car & Foundry Company.

The Chesapeake & Ohio has placed an order for 24 Mallet type (2-6-6-2) locomotives with the American Locomotive Co.

The Atchison, Topeka & Santa Fe is about to construct a seven-stall engine house estimated at $23,000 at Prescott, Ariz.

The Great Northern expects to extend its machine shops at St. Cloud, Minn., 60 teet, which will make that section of the plant 75 x 260 ft.

The Washington, Baltimore & Annapolis Electric has purchased 5 all-steel straight passenger coaches from the Cincinnati Car Co.

The Philadelphia & Reading is building 4 locomotives in its own shops of a new type (4-4-4) which will be [illegible] "Reading" Type.

The Chesapeake & Ohio has placed an order for 700 box cars with the Central Locomotive & Car Works and is in the market for 50 caboose cars.

The Boston & Albany has placed an order with the American Locomotive Co. to have 10 consolidation (2-8-0) locomotives converted to Mikado type.

Morgan's Louisiana & Texas Railroad & Steamship Company will construct new shop buildings and probably install some new tools and equipment at [illegible]

The Chicago & North Western has ordered 2,000 box cars from the Western Steel Car & Foundry Co. This road has also asked for bids on 10 coaches and 3 [illegible]

[illegible] Baldwin Locomotive Company has received an order from the Russian government for 250 locomotives for shipment within six months. The total price is said to be about $6,000,000.

The Pennsylvania Lines West have ordered 25 Consolidation type locomotives from the Lima Locomotive Corporation, and 25 Mikado type locomotives from the Baldwin Locomotive Works.

The Chicago, Rock Island & Pacific has asked for prices on five thousand 40-ton box cars. As soon as estimates are received the receivers will ask permission to issue receivers' certificates.

The Fort Worth & Denver City is reported to have ordered 10 locomotives from the Baldwin Locomotive Works as part of an order of the Chicago, Burlington & Quincy recently reported.

The Oregon-Washington Railroad & Navigation Co. is about to build a one-story, 10-stall roundhouse at Walla Walla, Wash. Moore Brothers, Portland, Ore., have the contract, and have just started the work.

The Russian government, it is understood, has in addition to the order for 250 locomotives from the Baldwin Locomotive Works ordered 100 locomotives from the American Locomotive Company, and 50 locomotives from the Canadian Locomotive Corporation.

It is understood that the Russian government has closed contracts for 22,000 cars as follows: 2,000 from the American Car & Foundry Company; 7,000 from the Pressed Steel Car Company; 3,000 from the Canadian Car & Foundry Company; 2,000 from the Eastern Car Company of Canada, and 8,000 from the Seattle Car Company.

The New York, New Haven & Hartford has authorized an expenditure of $600,000 for the installation of automatic block signals on its line, four-track, from Stamford, Conn., westward to the New York Central connections at Woodlawn, New York City, twenty miles. The controlled block system is now in use on this part of the road.

The Pennsylvania Railroad has placed an order for 7,043 freight cars, divided as follows: Cambria Steel Co., 300 box and 3,000 hopper cars; American Car & Foundry Co., 224 refrigerator, 1,000 gondola, and [illegible]; Pressed Steel Car Co., 500 gondola and 300 box cars; Standard Steel Car Co., 200 hopper cars.

Beginning of the Manufacture of Pneumatic Steel.

[illegible] are familiar with steel making operations are aware that the Bessemer converter is a pear-shaped vessel made of very refractory material and hung on trunnions that enable the apparatus to be tipped with little effort. An attractive part of the United States Steel exhibit at the Panama-Pa[illegible] original Kelly converter which was put into operation before the Bessemer converter was made.

In an address on the beginning of the manufacture of pneumatic steel by Robert W. Hunt, first superintendent of the Cambria Steel Works, he said:

"In 1860 William Kelly came to Johnstown and made some experiments on the pneumatic refining of iron. They were conducted in the cast houses of one of the old blast furnaces on the hill. He obtained some encouraging results. Later he returned to Johnstown and had built the miniature converter which is now part of the Cambria Steel Company's exhibit at the Panama-Pacific Exposition. This converter was originally located near the Cambria Iron Company's foundry, and the blast for it was taken from the small blowing engines which furnished the blast to the foundry's cupolas. This was after Bessemer had read his historic paper before the Iron and Steel Institute. Bessemer secured United States letters patent on his process. Kelly afterward made application for a patent, and the United States Patent Office granted it, leaving it for the courts to decide between Bessemer [illegible]

Later the Cambria Iron Company, E. B. Ward, Park Brothers & Company, Lyon, Shorb & Company and Z. S. Durfee formed a company to which Chouteau, Harrison, Valle & Company were later admitted, which purchased William Kelly's patent and Mushet's American patent. They built an experimental plant in the casting house of one of Capt. E. B. Ward's charcoal blast furnaces located at Wyandotte, Mich. Another organization known as Winslow, Griswold & Holley secured all of Bessemer's American patents and built an experimental plant at Troy, N. Y. In the meantime much legal skirmishing had gone on between the Kelly and Bessemer interests, which finally resulted in a consolidation, the Bessemer people receiving 70 per cent and the Kelly people 30 per cent. of the stock of the organization.

"All of this took time and added to the commercial uncertainties of the business; at all events, the directors of the Cambria Iron Company hesitated and delayed action. The Hon. Daniel J. Morrell was then the general manager of the Cambria Iron Company, and he was fully convinced of the merits and importance of the process, and was very anxious to [illegible] he was overruled. I remember hearing him say to the Cambria board of directors: 'Gentlemen, if you will pay me for my Cambria stock what you know it is worth, I will not hesitate to put it all into a Bessemer plant.' This was received by eloquent silence. So time went on, and, following the settlement of the patent controversy, several steel companies were organized and works built. As a result of this experimental and preliminary work on behalf of the Cambria Iron Company, the construction of a full size pneumatic steel plant was begun in 1870 and completed and operated in July, 1871."

Steam.

The expansive force of steam is nearly inversely as the volume, thus, if steam at 15-pound pressure occupies 1c. ft., the same quantity at 30-pound pressure would only occupy about ½c. ft. It contains about 5½ times as much heat as 1 pound good coal, evaporated 9 pounds water which has been raised to 212 degrees. Consumption of coal per indicated horsepower per hour in first class triple expansion surface condensing engines, about 1½ pounds in double expansion, from 1¾ to 2 pounds in single cylinder condensing 2½ to 3 pounds, in locomotives 2½ pounds, and in high-pressure non-condensing simple engines 3 to 4 pounds. —W. S. Hutton's handbook.

Designing New Standard Coupler.

A very important work recently carried on by the Master Car Builders' Association has been prepared to recommend a new and heavier form of a standard car coupler. The development of sizes has left the old form of standard coupler in the rear and it had become absolutely necessary that a new and stronger form should be brought into use. The Master Car Builders' Association appointed a special committee to work out the standard coupler problem and it has labored very industriously to produce the form wanted. It has collaborated with the manufacturers and has carried out road tests which were intelligently and laboriously made. The result of this work is that next year the Master Car Builders' Association will be in the position to recommend a new standard coupler likely to meet all requirements for many years to come.

A Sad Case.

The worried countenance of the bridegroom disturbed the best man. Tiptoeing up the aisle, he whispered:

"What's the matter, Jock?" Hae ye lost the ring?"

"No," blurted out the unhappy Jock, "the ring's safe eno'. But, mon, I've lost ma enthusiasm."

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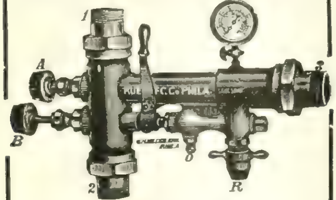

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Books, Bulletins, Catalogues, Etc.

Franklin Automatic Driving Box Lubricator.

The Franklin Railway Supply [illegible], New York, has issued somet[illegible] in the way of a descriptive catalogue relative to the Franklin driving box lubricator. The device has made possible the use of grease instead of oil. One packing will last as long as fourteen months. It is constructed to feed hard grease automatically to locomotive driving journals. It consists of a perforated plate, which fits against the journal and regulates the feed of grease; a follower plate, with spring, which supports the grease cake and keeps it in contact with the perforated plate; and indicators, which show the amount of grease in the cellar and which are used for pulling down the follower plate when repacking the lubricator. These parts are contained within the cast iron cellar. It is all reliable, easy and economical. Get a copy of the elegant catalogue and be convinced.

Polarized Metallic Boiler Chemicals.

The Bird-Archer Company, New York, has published a treatise on locomotive type of boilers and the results obtained in same by the use of polarized chemicals. The author of this article has given for ready reference what he considers good practice in locomotive boiler design, care and maintenance, including directions for proper washing-out of boilers. The latter is thorough, and there are also general directions for the use of polarized metallic boiler chemicals. There is much information showing how some railroads have attained such high boiler efficiency at low cost. The booklet is well worth perusing. The effect of polarized mercury on a boiler may be briefly said to be the formation of a surface film or coating similar to an electro deposit. This surface film cannot be affected by sulphuric acid or any weaker deposit. A boiler treated in this way cannot be corroded. Read the booklet and be convinced. Send for copies to the company's New York office, 90 West street.

Gold's Lock Coupler.

The devices of the Gold Car Heating & Lighting Company, 17 Battery Place, New York, spring into being and take their places for which they are constructed with singular fitness. Among these a positive lock coupler [illegible] met with hearty approval. It absolutely prevents scalding of employees. Being light there is less wear on hose, the number of gaskets are greatly reduced. It is easily coupled and uncoupled, and locks perfectly with all other makes. The coupler [illegible] known gravity safety trap of new design which is [illegible] viously produced. This valve is tight when steam is on and opens when steam is off. It is really a safety appliance of the first rank. Send for a copy of circular No. 8,048 and get fuller details.

Graphite.

This fine periodical runs smoothly in its triumphant way. It is now eighty-eight years since Joseph Dixon, scientist, inventor, chemist, machinist, sociologist, humanitarian, founded the business now known as the Joseph Dixon Crucible Company. The plumbago crucible was one of his inventions. Almost every year has seen some new use made of graphite until at the present day there is not a civilized point on the entire world that does not make use in some form of some adaptation of Dixon's discoveries. "Graphite" tells the story from month to month. Get a copy of the June or July issue and mark the progress of events. Perhaps the most recent but not the least successful use made of graphite is in the manufacture of pencils. They are now made by the million, and are in every hand.

Newton Slotting Machines.

Catalogue No. 49, just issued by the Newton Machine Tool Works, Philadelphia, Pa., presents in descriptive matter and illustrations a complete line of the company's standard and special slotters. There are also designs of milling, boring, drilling and cold saw cutting off machines. The use of high speed steel and the adaptation of motor drive has necessitated the redesigning of these machines, and the degree of perfection to which the company's products have arrived are not surpassed. The machines embrace every variety of movement including rack driven, stationary and screw driven portable slotting machines, also motor driven by means of straight and crossed belt, pneumatic clutch, or reversible motor as desired. The thrust of screw, or screw driven machines, is taken by roller bearings submerged in oil. In accordance [illegible] gears are covered, but a complete description of these fine machines can only be fully obtained by a perusal of the catalogue, copies of which may be had on ap[illegible]

The Output.

[illegible] Hoboken, N. J., publish a 12-page magazine now and then descriptive of the company's products and installations of their lighting systems. It is very illuminating. The testimonials to the efficacy of the company's electric lamps confirm the

[illegible] pared with the diffusive splendor of a [illegible] The [illegible] signs manufactured by the company, and which are rapidly gilding the continent here and there into glorified spots, are wonders to behold. An interesting feature about these signs is the absence of halation, which is so frequently noticed in connec[illegible] sign. The method of mounting these signs and other interesting matter are shown in the "Output" and also in Bulletin No. 59, copies of which may be had on application to the company's office, Eighth and Grand streets, Hoboken, N. J.

"National" Pipe.

Catalogue J, comprising material manufactured at Kewanee works of the Na[illegible] "National" pipe for steam, gas, water and air, cast iron, malleable iron and brass fittings, "Kewanee" unions and specialties, and other devices, has just been published and is something unique of its kind. Extending to about 400 pages, each page illustrated, printed on superfine paper, and bound in morocco, gilt-edged and ornamented, it is the best publication of its kind. Its supremacy is easy and complete. Of the myriad matters it treats of, [illegible] The union of brass and iron in union and valve construction has been carried to a degree of perfection by the enterprising company to an extent undreamed of, and the gorgeous catalogue is an admirable reflex of the perfect work that it repre[illegible] company are at the Frick Building, Pittsburgh, Pa., but there are now offices in about twenty of the leading cities in the United States. The Kewanee works are being constantly enlarged, the system of [illegible]

Safety on the New Haven.

[illegible] Railroad's system has been covered by an efficiency organization, whose object is to promote safety and to secure greater [illegible] virtually all the employees of the road's [illegible] terminals. The minutes of these meetings are sent to the committees of all the other divisions, thus providing for a general exchange of information and ideas [illegible]

Electric Gearing

The R. D. Nuttall Company, Pittsburgh, Pa., has issued Catalogue No. 13, covering electric railway gears, pinions and trolleys. This publication gives general data on Nuttall railway motor gearing for Westinghouse and General Electric equipments, Nuttall trolleys, harps, and wheels, flexible couplings of the spring and buffer type, and electric railway compressor gears. This publication is of special interest to the electric railway field.

Dispute About Locomotive Headlights.

The vicious tendency of state legislatures to make laws for the regulation of railroads is well illustrated in a case that recently happened in Mississippi. The legislature of that state passed a law stipulating that all locomotives on main lines in that state should be equipped with electric headlights. This law conflicts with a United States statute which removes from state legislatures the question of compelling railroads to equip locomotives with electric headlights. The United States court at Jackson, Miss., has issued a temporary injunction restraining all district attorneys in Mississippi from prosecuting railroads that are violating the state law by failure to equip their locomotives with electric headlights. The case will now occupy the attention of various courts.

Locomotive Chart.

The Locomotive Publishing Company, Paternoster Row, London, England, has issued a new locomotive chart showing a ten-wheel, 4-6-0 type of locomotive, built by the North British Locomotive Company, for the Great Indian Peninsula Railway. The chart shows every part of the locomotive and tender, and all the parts are numbered and named, the total [illegible] 240. The chart is about 12 inches in height by 36 inches in length. It is printed on toned paper, and the drawing, which is excellent, is tinted. The price of the chart is one shilling or twenty-five cents, postage free to any address.

[illegible]

N. Y.; Stockholders: Angus Sinclair, 114 Liberty St., New York; James Kennedy, 114 Liberty St., New York; Harry A. Kenney, 114 Liberty St., New York; Mrs. [illegible] J. Schinbacher, 114 Liberty St., New York.

[illegible] day of April, 1915.

Mr. C. B. Yardley, formerly manager of railroad department of Wm. C. Robinson & Son Company, Baltimore, Md., has resigned his connection with that company to take the management of the railroad department of the Lubricating Metal Company, 2 Rector street, New York, manufacturers of metallic packing, bearing metal and die cast bearings.

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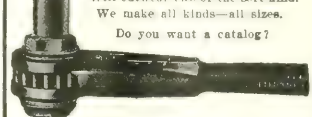
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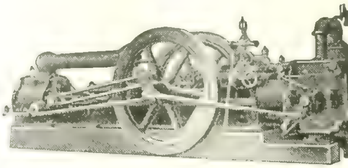
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Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVIII. 114 Liberty Street, New York, August, 1915. No. 8

In the Deschutes Canyon in Oregon

The railroads in Oregon are so full of spectacular engineering accomplishments, and the history of their construction are so full of romance that volumes could be written and illustrations could be furnished that would make a panorama at once stirring and unique. The building of the railways in Oregon was the outcome of the desperate fight between two railway magnates, Hill and Harriman, [illegible] of infinite resource and unlimited means. Each commanded the finest engineering ability necessary, and each was full of determination. [illegible] was the opening of the [illegible] of central Oregon. There [illegible] one available route and that was by the Deschutes river, which before it joins the Columbia river follows a meandering course between towering walls of rock. [illegible] without success, and finally both sides [illegible] rival promoters and operations begun. The fight for the possession of the requisite territory was strenuous, a [illegible] the elemental forces of nature in a narrow canyon but a continuous battle between bodies of lawless men. In spite of all this the work went on. The [illegible] one bank, while the Harriman [illegible] river.

[illegible] frontispiece illustration shows a [illegible] the river at a point where the [illegible]

THE "HORSE [illegible]

[illegible]

Around this loop of the river the Oregon Trunk line, built by J. J. Hill, taking the left bank, sweeps right around the curve, while the Harriman road, on the opposite bank, tunnels through the [illegible] the curve, as shown by the dotted line.

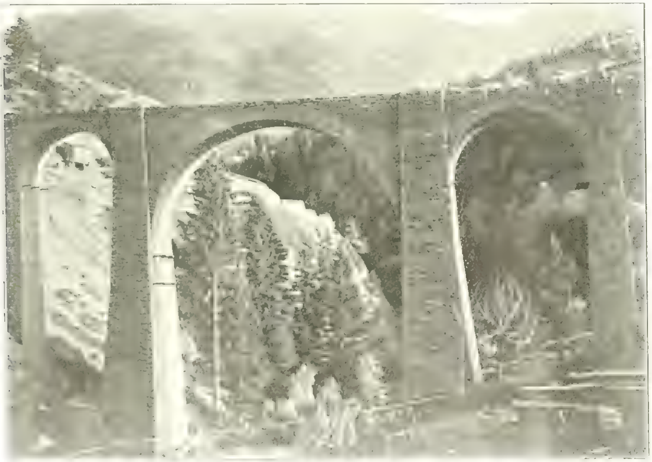
In [illegible] Deschutes Canyon the Oregon Trunk line crosses the Columbia river in order to effect a junction with the Spo[illegible] this point the river is 3,500 feet wide, [illegible] was inevitable. The structure measures 4,200 feet in length. The single track bridge, built entirely of steel, [illegible] concrete and granite. A peculiarity of the bridge is the bifurcated approach [illegible] the waterway. This provision greatly facilitates the operation of the trains, those proceeding to and from Portland taking the western leg, while traffic to and from Spokane follows the eastern [illegible] the bifurcation.

THE FURKA RAILWAY.

The Connecting Link Between The Rhone and The Rhine.

By [illegible]

When the Simplon line was inaugurated in 1906, there was probably no other city [illegible]



[illegible]

[illegible] Route. A few years later, [illegible] in the [illegible] the celebrated Lotschberg Railway, [illegible]

district and where it formerly required a long railway journey via Montreux and Spiez to reach Interlaken, or a diligence drive via Gletsch to Meiringen, followed by a train and boat trip to Interlaken, this modern Alpine road takes a short cut [illegible]

[illegible] SECTION OF THE NEW FURKA [illegible]

Alps, to Kandersteg, Spiez, Berne and Interlaken.

The Simplon Railway forms the international highway from the Lake of Geneva [illegible] the Rhone Valley [illegible] Italy and vice versa, and the Lotschberg Line, con[illegible]

$42\frac{1}{2}$ miles, runs from Brig to Andermatt, at the foot of the Oberalp Pass. From Andermatt, which will shortly be connected with Goschenen, on the Gothard Line, by a $2\frac{1}{2}$-mile-long electric railway, running close to the road through the Schöllenen, the Oberalp Pass, practically a continuation of the Furka road, leads to Disentis, an ancient monastic village with recently discovered radio-active mineral springs, a distance of 18 miles.

From Disentis the Rhaetian Railway affords direct communication with all the noted Grisons resorts. To cover this entire distance of $60\frac{1}{2}$ miles requires a diligence journey of one day between Brig and Andermatt and $4\frac{1}{2}$ hours between Andermatt and Disentis, a fascinating drive for the tourist who is fortunate enough to be able to travel with leisure, but often out of the question for those who are somewhat limited for time.

The construction of a railway which would form the connecting link between Brig and Disentis came therefore up for [illegible] and the construction of the line was started in [illegible] of the first section Brig-Gletsch took place, but four weeks later, when the railroad was actually ready for traffic, the European war broke out and, in view of the completely reversed conditions, it was decided that the line would only be opened for the summer season, 1915. The trip by rail from Brig to Gletsch takes 2 hours; the sections Gletsch-Andermatt, Andermatt-Goschenen and Andermatt-Disentis, which will also be open for traffic [illegible] hour and $1\frac{1}{2}$ hours respectively. The new Alpine railway will thus cover the total distance of $60\frac{1}{2}$ miles in 5 hours.

The railway has steam traction. It is [illegible]

ion sections and possesses an extraordinary number of interesting features from an engineering point of view. There are over 50 viaducts, bridges and galleries; 7 tunnels and 5 loop tunnels. The maximum gradient is 1.10 per cent., and the total length of the rack and pinion sections is 19½ miles. It is estimated that the cost of construction for the line Brig-Gletsch-Disentis is over $7,600,000.

Grand Trunk Pacific Railway.

That stupendous enterprise, the Grand Trunk Pacific Railway, which the Canadian Government has [illegible] for years, seems to have encountered difficulties. Some 1,800 miles of steel rails have been laid, extending from Moncton, N. B., to Winnipeg, Man., but the promoters of the enterprise have declined to undertake the operation of the line until the whole of the railway is completed to the Pacific Coast.

The Grand Trunk Pacific Company signed a contract to take the railway over for operation on completion, paying for fifty years, as rent, 3 per cent. of the cost of construction.

The Grand Trunk Pacific Company, in declining to sign the lease or to begin operation, claims that terminals at Quebec have not been finished and that in other respects the road is incomplete. This the Government disputes. It is to prevent the destruction of the line by frost and flood that the Government proposes to inaugurate a train service of its own.

That the line may be added permanently to the Canadian Government railway system is indicated [illegible] presented to Parliament.

Railroad Construction at Night in Africa.

Railroad construction at night is made possible, says a scientific journal, by the use of a freight car as a lighting plant. Projecting from a tower built at one end of the car is a light arm that extends far out over the track. At the extreme end of this arm two searchlights are placed, while other lamps are located at intervals along the arm. By means of this arrangement plenty of light can be shed upon the portion of the track that the arm overhangs, while beams of the searchlights can be cast ahead where the work of preparing the roadbed is under way. The lighting plant permits of carrying on work in the cool hours while the torrid sun is below the horizon.

The hardest kind of steel may be drilled with ordinary drills by using a lubricant of one part of spirits of camphor and four parts of turpentine. Mix thoroughly and apply cold, allowing the solution to remain a short time before applying the drill. Run the drill slowly with fine feed.

Pike's Peak Rack Railway

Nearly Three Miles Above Sea Level

Perhaps the best thing that has come out of the European war so far is the effect that it is having on the American tourists. They are staying at home, or what is just as good, they are rattling around in their own country. Thousands of them when they start out do not know where they are going, but keep on their way. Their experience is full of surprises. In crossing the Continent from the Atlantic to the Pacific within the last two months, we have had [illegible] meeting many of them, and [illegible] stance have we seen or heard any indications of disappointment at the ever-changing panorama of America's scenic wonders, either in the phenomena of nature in her sublime grandeur [illegible] ous achievements of human industry as manifested in the expanding cities through which the lines of traffic pass.

ON THE STEEPEST PART OF [illegible] SNOW [illegible]

A prime favorite among the tourists this year is the ascent of Pike's Peak in Colorado. The semi-night service is particularly popular. One train leaves the lower terminus late in the afternoon and reaches the summit in time to witness the gorgeous spectacle of the setting sun, and, spending the night at the Summit Hotel, one is able to view the equally enthralling dawn of another day. One of the most popular trips is the Sunrise Excursion, which, leaving the lower terminal at midnight, lands the travelers at the crest in time to see the sun creep over the eastern horizon. This special service has developed to such a degree that the entire equipment of the railway has to be impressed to cope with the crowds.

It may not be generally known that the road is only opened early in June and its continuance depends on the severe snows which set in early in the fall. On the upper five miles there is frequently snow falling in July, and the road is occasionally blocked as the snow packs very hard in the upper exposed regions. Clearing out the snow is a difficult operation as there is no mechanical appliance which can cope with the frozen layers of snow and ice. Trenches are cut in the solid mass and blocks about nine feet square are transferred to a flat car. The train with a load of blocks runs back along the line until a ravine is reached. The blocks are then slid off the car and sent tumbling down the mountain side.

The rack-rail system in use comprises a rack made of Bessemer steel, with the teeth cut from the solid mass of metal. It is built up in lengths of 80 inches. The rack-track comprises two of these rails laid side by side centrally between the outer metals, and set about 1½ inches apart. The rack-rails are so laid that the joints of each length do not come in line, while the teeth of one is brought opposite the space between two teeth of the other. This secures an even bearing at all times, and is conducive to smooth traveling.

The railway measures a little over 39 miles in length and the gradient is 844.8 feet per mile, the highest grade being 25 in 100. The sharpest curves are 16 [illegible] large portion of the rails and rack are anchored to the solid rock, 146 of these anchors are used throughout its entire length. The highest point on the mountain is 14,147 feet above sea level. The railroad is the longest rack-rail road in the world. No personal injury has occurred from its operation, and, it has been [illegible] it seems to grow in popular favor with [illegible]

An Introduction to the Study of Air Brakes

By WALTER V. TURNER, Assistant Manager Westinghouse Air Brake Company

Part II.—Thorough Study of the Principles Which Govern the Design Necessary to a Mastery of the Subject

[illegible] only the [illegible] air brake [illegible] times [illegible] as, for instance, a train of 100 vehicles as compared with a train of two vehicles, the cause of operation remains the same, yet the addition of each part or car makes more difficult the producing of the cause of the operation of the air brake, namely, the difference of pressure between the brake pipe and reservoir, essential to its application and release. The reason why it becomes difficult is because the volume of air to be changed in pressure increases so that when the train consists of, say, fifty cars, the volume of the system is increased tremendously as compared with a train of, say, five cars. Therefore, the reduction in pressure takes place so slowly that a difference in pressure between the brake pipe and the reservoir is more difficult to obtain, for while the partition which divides these volumes may fulfill its purpose effectively with a fairly rapid change of pressures, it may fail altogether where the change takes place very slowly, and in any event, the application of the brake, where the number of parts that go to make up the unit is great, becomes very slow because the pressure cannot flow to the cylinder at a more rapid rate than the brake pipe pressure is being reduced and, of course, the release of the brake (considering it as one) becomes slower with a long train than with a short one. It is this failure to take into consideration the time element in air [illegible] improper manipulation and to so many misconceptions regarding it.

If in the application of the principles which govern the design and operation of the air brake, the student will bear in mind that there can be no effect without a cause, the greatest difficulty in understanding not only why the brake operates, but also why at times irregular operations take place would be removed, and what follows is intended to illustrate this.

[illegible] not, strictly speaking, a reduction in pres- [illegible] reservoir which moves the triple piston and slide valve, if this difference in [illegible] movement of the operating parts; and, [illegible] brake, but an increase of brake pipe pres- [illegible] movement of the triple piston toward release position, therefore, if there is any [illegible] which prevents the attainment of this difference in pressure between the two vital volumes concerned, namely brake pipe and reservoir, the movement of the triple piston will not take place, that is, the brake in the one case will not apply and in the other will not release. As an example of what is meant: if the air can feed back from the auxiliary reservoir, through the feed groove or by a loose or stuck packing ring, to the brake pipe at the same rate as the brake pipe pressure is being reduced, the brake will not apply. If when the brake is applied, in attempting to release it by increasing the pressure in the brake pipe, the reservoir pressure rises at the same rate, which may happen in the event of a loose or stuck packing ring or worn piston cylinder bush, the triple piston will not move to release position and consequently the brake will not release. In other words, the operations of the brake are produced not merely by a reduction or increase in pressure, but by differences in pressure (in fact all the air may be exhausted without applying the brakes unless the proper difference of air is created) the parts always moving toward the lower pressure when the difference is great enough to overcome the resistance of friction, etc., and remaining stationary when the pressures again become equal.

The operation of the air brake is due to that property possessed by air of always tending toward a state of equilibrium with [illegible] throughout any self-contained closed system. Thus, in the brake system, if, when pressures are equal, this relation is destroyed, the movable parts upon which the pressures act will move in the direction of the lower pressure, and this movement may alternate in either direction according as the pressure is highest first on one side and then on the other of the dividing movable part. This is illustrated by the movement of the triple piston, which, [illegible] toward the lowering brake pipe pressure, then when [illegible] lower, because air is flowing from it to the brake cylinder, the direction of movement [illegible] triple piston moves toward the now lower [illegible] the auxiliary reservoir, a state of ap- [illegible] parts become stationary and will remain so until the relation of pressures is again changed.

If these principles which govern the brake are understood, any problem involving the operation of the brake may be readily solved and this applies not only to one type of equipment, but to all types of automatic brakes. Here we see the difference between learning to trace the air through ports and passages and understanding the principles of operation, for if the brake applies, the pressure of the brake pipe must have fallen below that of the reservoir; if the brake releases, the pressure in the brake pipe must be higher than that in the reservoir; if the brake does not apply or release, when apparently it ought, most certainly the difference of pressure essential to its operation is not being obtained and as the law in the case is positive and invariable, there can be no deviation from what is herein set forth. A realization of this will produce the state of mind necessary to approach a problem in connection with any particular device, for knowing what parts are subject to pressure, during the operation being considered, it becomes a comparatively easy cause, and, therefore, reach an intelligent conclusion as to whether the operation is normal or abnormal, or whether produced by defect or disease.

It is plainly pertinent here to mention that when considering the operation of the air brake, it must be considered as a whole, and not the different valves separately, for each part is influenced by some other part and the [illegible] equipment, combining everything in the system from the air inlet of the compressor to the angle cocks on each end of the train, therefore, any evidence of irregular operations in any particular part may be the effect, not of the defect or disease of that part but of some other in the system. For example, a brake may apply without any intentional brake pipe reduction having been made—this should not be taken as conclusive that there is anything wrong [illegible] triple valve [illegible] this particular car, for it may be due to [illegible] pressure in the brake pipe not being [illegible] valve against leakage; in other words, the triple valve may be more sensitive than the feed valve which is contrary to natural conditions [illegible] may be readily [illegible] by thoughtful inquiry.

[illegible]

Certain Analogies Existing Between Steam and Electricity

By T. E. REARDON, Pittsfield, Mass.

Only a very few years ago, before electricity had become a factor of importance in the world of traction, the steam engineer, whether he was a locomotive runner or in charge of stationary engines, he was but indirectly interested in the generation, transmission and use of electrical energy. Now that many locomotive engineers are called upon to change over from the steam locomotive to the electric locomotive and that many others as a matter of choice are entering the field of electric station engineering service, it follows that any exposition of general electrical principles based upon the various analogies between steam and electricity should materially assist in clearing up matters that of necessity must be somewhat hazy in the mind of the man who finds himself in an entirely new field.

While strict analogies cannot be made to hold in every instance between steam and electricity, still, however, the coincidence is sufficiently close in numerous instances to render reasoning by analogy of much service in the exposition of general electric principles. To commence with, the unit of pressure, in steam practice we have the familiar lb. per square inch, which is so familiar and so well understood that its significance requires no elaboration. In the measurement of electrical pressure we have as the practical unit of pressure the volt, which corresponds exactly with the lb. per square inch in the case of steam pressures. The value of the volt is usually defined as 1/1.434 of the voltage of the Clark-Latimer cell of battery, which is made up according to specifications and used at a certain temperature. For the purpose of practical illustration it may be said the ordinary cell of dry battery has an electro motive force of 1½ volts, 1,000 such cells connected in series would have an electro motive force of 1,500 volts. With electricity as with steam the higher the pressure the smaller the flow of current required for the delivery of a given amount of power. In both cases, however, higher pressures must be resisted owing to the disruptive tendencies that tend to overcome the restraining influences. In the case of high pressure steam, the boilers, piping and engines must possess increased strength in order to withstand the disruptive force and this matter must be considered in connection with a liberal factor of safety. Accompanying high steam pressure, there is also high temperature and the losses incident to escape of heat by [illegible] must be guarded against and [illegible] a liberal amount of heat [illegible] covering. In the case of electricity, the dielectric strength of insulating material takes the place of the tensile strength of pressure resisting material used in steam practice. The electrical pressure tends to break down the dielectric strength of the insulating covering and to make short paths for itself in the same manner that the steam pressure tends to rupture the boiler plate or to burst the pipes. The causes in both cases vary with the pressures employed and the [illegible] dielectric strength that is absolutely safe in one case would be hazardous and utterly worthless in another case. As boiler plate is tested for strength in a hydraulic testing machine, so insulating materials are tested for dielectric strength by subjecting them to a high difference of potential until breakdown occurs, which shows the ultimate strength. The factors of safety chosen in the dielectric strength of insulating materials are vastly greater than they are in case of tensile strength resisting mechanical strain, being usually from 5 to 10. The cross section of steam pipes and the cross section of electrical conductors vary in a similar way, depending upon the volume of the flow and the length of the lines. Drop in pressure occurs in both cases and it reduces the effective working pressure at the engine in one case and at the electric motor in the other case. The steam boiler and the dynamo are alike generators of pressure, but with certain distinct features. Two or more steam boilers can be connected to a common steam main, the pressure in each boiler being the same, when the boilers will furnish equal or different volumes of steam, but always at equal pressure.

There is, however, no method whereby two boilers can be connected together in such a manner that the pressure in one boiler will be added to the pressure in the other boiler. While such practice is not at all common, two dynamos can be connected together so that the voltage of the one will be added to the voltage of the other. In common practice several dynamos are connected in parallel to common bus bars, exactly as a battery of steam boilers are connected to a common steam main. Steam after leaving the boiler is frequently superheated, which increases its store of energy and renders it capable of performing a greater amount of work. Electrical energy after leaving the dynamo is frequently transformed up or down, i. e., its voltage is either raised or lowered [illegible] store of energy [illegible] time that the voltage increases or decreases, the amperage or volume of current suffers a change exactly opposite in character. As a matter of fact the store of energy is slightly decreased, due to the slight loss that occurs in transformation.

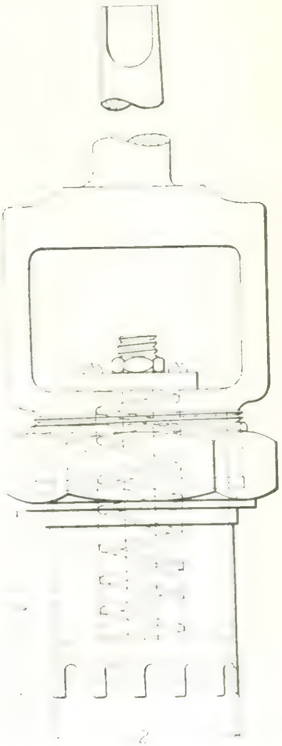
In studying phase diagrams of 2-phase and 3-phase open connected armature windings the engineer will note that such phase windings generate electro motive forces that vary between zero and a maximum and that at certain points in the cycle they assist each other and at other points they oppose each other. In two-phase winding, one phase is 90° behind the other phase, just as two locomotive cranks are set quartering, and the net maximum effect occurs in the electrical case just as it does in the mechanical case, when each phase or crank is 45° from the dead center line, that is maximum voltage in the electrical case and maximum rotative effect in the mechanical case occurs at the same point in the cycle. A generator with a 3-phase star connected armature-winding is similar to a 3-crank engine with cranks 120° apart. Maximum voltage in one case and maximum rotative effect in the other case, will occur with one phase or crank 60° above the line, the other phase or crank 60° below the line, with the third phase or crank on the zero or dead center line. The reason for this is that voltage or leverage is proportional to the sines of the angles through which the phase or crank has advanced. As the sine of 60° is .8660 [illegible] cranks, at these points in the revolution or cycle have a value of .8660 each, which equals 1.732, while one crank or phase in the 90° position has only the value of unity, the sine of 90° being 1. The voltage of a three-phase star connected armature winding is therefore 1.732 times the voltage generated in one of its phases windings. As in the case of the 3-crank engine, as one phase approaches the zero or dead center line the other phase is departing from zero and increasing its value. In arriving at the mean effective pressure on an indicator card from a steam engine the mean effective pressure is equal to the average of the heights of the several ordinates, but in obtaining the mean effective voltage from a sine curve wave diagram of a. c. voltage it is necessary to take the square root of the average of the squares of all the ordinates.

[illegible]

[illegible] best it is believed that this method [illegible]

Asbestos Cutter.

[illegible] that [illegible] Keely [illegible] that [illegible] The cellular asbestos is 1½ inch thick, and full of air cells and requres a sharp cutter to cut good clean holes, which are [illegible] hole is 2 inches in diameter and allows inspection of stay bolts, and removal of same, without removing jacket. The cutter, you will note, is made of tool steel ⅛-inch thick, and the 12 teeth are sharpened to knife



[illegible] shoulder and is held in place to body by hexagon nut as shown. The body part [illegible] running the cutter about 400 revolutions [illegible] will [illegible] plunger with spindle and [illegible] asbestos each time the spindle [illegible] piece of asbestos after each hole is cut, as it [illegible] shoves out each piece cut

Advantages of the Superheater Locomotive

By G. A. STONE, Locomotive Engineer, Moncton, N. B.

One of the most difficult problems that has to be faced by the Locomotive Superintendents of today is the necessity of materially increasing the hauling capacity of their locomotives without unduly increasing their weight. This has been brought about by the gradual increase of the weight of the rolling stock, the desire for greater speed, and punctuality in service.

When we take into consideration the restrictions of the permanent way, and the strength of bridges, we realize then that the axle load cannot be increased beyond certain limits. Therefore, this combined with a desire to curtail the enormous sums expended yearly for coal, and minimize the number of trains, as much as possible, especially on single track load. Locomotive Superintendents undoubtedly have their attention focused on the most feasible and simplest means of solving at the least possible cost, the problem of obtaining the most serviceable and economical locomotive constructed to meet required conditions. This has brought to their notice the superheated engine which has for some years been successfully operated on the Prussian State, Belgian, and other European lines, with remarkable success, previous to its introduction in this country. Recently British railroads which were decidedly conservative on the subject of superheating, are now adopting it as quickly as superheaters can be fitted, much of this class of work being done during 1914, the Schmidt device being con- [illegible]

The Schmidt fire tube superheater dates from 1897, when it was applied to two [illegible] other different designs coming into use since that date. According to Schmidt, the term Highly Superheater Steam is restricted to steam that has been raised to about 180 degrees Fahr. above its proper saturation temperature, by subjecting it to a further heating in an enclosed vessel termed a Superheater. Saturated steam as it exists in the boiler is always on what has been known as the "dew point" and experimenters have found that with saturated steam the loss from condensation before it reaches the cylinders varied from 20 to 40 per cent, according to the cooled [illegible] way to same. Superheating the steam before it reaches the cylinders prevents this loss because steam could endure some loss of heat without turning it into water and after entering the cylinders exert a greater expansive force than obtainable with saturated steam.

Also by superheating steam, locomotives can be operated with lower steam pressure, which has its advantage in eliminating boiler troubles. The locomotive engine has been found to be particularly addicted to losing heat from cylinder condensation owing to the exposed position of the steam chests and cylinders. Numerous methods were adopted to try and prevent the heavy losses due to cylinder condensation, cylinder jacketing for a time being considered somewhat of a preventive. However, it was found that benefits derived from this were small and all methods to eliminate the losses came to naught until the practice of superheating was introduced. Consequently, the necessary apparatus for superheating steam is one of the most important improvements added to the steam engine for many years.

Mr. H. H. Vaughan, of the Canadian Pacific Railway at a meeting of the Master Mechanics' Association in 1905 stated that, "speaking generally, the maintenance cost of a superheater steam locomotive is not necessarily greater than that of an ordinary engine of the same size, for although certain supplementary costs are incurred, they are compensated for by saving in other directions." During the past 10 years the truth of this assertion has manifested itself, for the mechanical world of today recognize now as an undisputed fact, that with the appliances now in use for superheating, a real gain in fuel economy and tractive power has been made of about twenty (20) per cent. The only offset to this gain, being in the cost of the necessary appliances and the maintenance of same, which are gradually diminishing, while the gain is apparently increasing.

The general operation of the superheater locomotive is similar to the ordinary saturated steam locomotive. Cylinder cocks must be kept open when starting until dry steam appears and lever placed in full gear position to insure proper oil distribution the full length of valve bushing. In general, superheated steam locomotives should be operated with full throttle and short cut-off when working conditions permit. On account of the large diameter of cylinders used in superheated engines, the throttle must be opened slowly and special care taken to prevent slipping of drivers. The engineer should know that the superheater damper is open while using steam and closed when steam is shut off. These rules are recommended by the Superheater [illegible] lowed out in their entirety, and in addition it is advisable before starting, to have lubricator working some 10 or 15 minutes for oil to reach valves and cylinders so they may be properly lubricated and when drifting if engine is not equipped with drifting, or booster valve, the throttle should be slightly cracked in order to carry oil to valves and cylinders and prevent oil from carbonizing on walls of cylinders by sud-

den rush of cold air in cylinders and avoid probable damage to cylinders, or breakage to motion. It is therefore important that a little steam should be worked through cylinders of this type of engine when drifting. As an engineer of some experience on this class of engine, I believe that rod brasses and crossheads can be better kept up, if this is done, as it also prevents the sledge-hammer pound so noticeable when engines of heavy type are drifting with steam shut off. To get best results in service for steam, firemen should always keep a level fire, as thin as conditions will permit at a bright white heat over the entire grate area. The firing should be light and regular to produce as high a flame temperature and as perfect combustion as possible in the firebox. Banked coal in firebox destroys that much surface, that should be utilized for heating purposes, and a smoky fire has a low temperature which undoubtedly reduces the degree of superheat, and therefore uses more coal on the trip.

To get good results in road service the importance of keeping flue and superheat units clean and tight cannot be too strongly emphasized. Tubes should receive particular attention at the end of each trip. It cannot be expected that a fireman can give the results expected of him unless this particular work is constantly attended to by the shop force. Leaks in the front end, or superheater units, flues stopped up and derangement of draft appliances not only affect the steaming of the engine but reduce the degree of superheat. I know of one case where a clinker formation was found in the large tubes on the end of the superheater units which was over 4 inches thick. Therefore it is necessary that these tubes should be properly cleaned, or otherwise if they were all allowed to get in this condition the engine would be practically converted into a saturated steam engine of the poorest kind. In addition to this, blows in cylinder packing and valves should be promptly reported and attended to, as they will probably cause scoring due to removal of oil from wearing surfaces. Damper cylinders of Schmidt superheater type of locomotive should be equipped with a small oil cup, same as in use in the Vaughan-Horsey type, 204 class. This would minimize the trouble occasionally arising from a superheater damper [illegible] properly.

Much more might be said in favor of the Superheater engine, but I would like to hear from other engineers who handle this particular type of locomotive. In conclusion, I would strongly advise engineers to report promptly, all defects of their engines; it is often the small things that count, and if reported promptly so they can be attended to, will prevent larger troubles originating. Many railroads have found themselves drifting towards the Bankruptcy Court because the small leaks were not more closely watched. Therefore the same will apply to your locomotives. Watch the small things; see that the work is done; cultivate a keen interest to have better working conditions, and at the same time prevent your engine from becoming a scrap pile.

Boiler Construction.

By Wm. H. Wood, Media, Pa.

Referring to M. M. Convention at Atlantic City, and report of committee on designing construction and inspection of locomotive boilers, make no mention or recommends any new designs to overcome the difficulties explained in the movement of the fireboxes and tube plates, but the report clearly acknowledges the trouble which exists with the present flat plate construction both with and without a full installation of flexible stays. The apparatus for testing something which is known to exist in the present construction, however, much may be done in this direction, will not change or lower the cost of motive power expense to the railroads, therefore, without the plates are formed to neutralize stresses such as are indicated by the testing apparatus by Messrs. MacBain & Fowler on construction of which the conditions are known to exist, no improvements can be recognized by the committee, notwithstanding, there are well defined principles to overcome expansion and contraction in all manner of construction, and which are being made use of in all kinds of manufacturing, where stresses have to be dealt with, and which are recognized by prominent engineers all over the world, yet, with the destructive conditions occurring in locomotive boilers. These principles are boycotted in boiler construction, although it is practically the solution of the whole problem, and until the locomotive boilers are changed to conform we may look to the same existing conditions that exist today, which cannot be changed until an equalizing formation is made in the plates entering into the construction, which is now acknowledged to be less costly.

The flexible stay, which in its perfect state may move with the movement of the plate, while it is free from incrustation, but it will not neutralize the stresses as would the formation in plates, and when you consider that the outside wrapper sheets of fire boxes where a full installation of flexible stays are used say 2,700 in number, the sectional area is reduced by 5,843 square inches, whereas, in the boiler with a complete shallow corrugated firebox, the sectional area is added to the outside wrapper sheet of firebox by 208 square inches by the lesser number of stays required, and the inside of the firebox is made nearly eight times as strong as if made with flat plates. It will be [illegible]

[illegible] boilers will be allowed to remain.

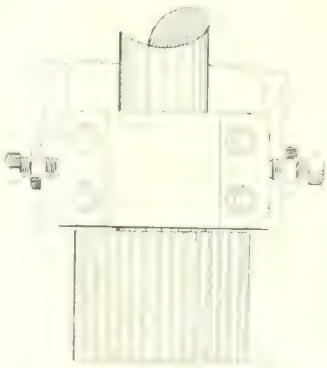
The Walschaerts valve gear met with the same neglect on account of its being somewhat of a radical departure from set plans, but at this time it is practically universally being used. There must still be dormant fire which requires lighting in order to assist the motive power expenses to come below thirty-three per cent. of the gross earnings of the railroads as it is now reported to exist.

Repairs on a Bridge Bearing Box.

By J. G. K[illegible]

[illegible]

One of the difficulties encountered in the operation of the drawbridge No. 6, at Soo, Michigan, supervised and maintained by the Duluth, South Shore & Atlantic Railway, was in the rapid wear of the bolts on the main driving pinion bearing box.



[illegible]

The bridge was constructed in 1884, and to say the least, bridge designing has been considerably improved upon since that date. As shown in the accompanying illustration, the bearing-cap and the brass were held in position by the use of four one-inch bolts. The shafting being three and five-eighths in diameter, bolts of one inch in diameter were repeatedly proven to be too light for the service. The trouble has been remedied by reboring the bolt [illegible] ter in diameter, the bearing casting being sufficiently large to admit of the increase in the size of the holes. Two holes were also drilled and tapped in the angle-plate [illegible] that has elapsed since that time no trouble has been experienced with the [illegible] and will not likely be for a long period of time.

Progressive Apprentices

By H. E. BLACKBURN, Instructor of Apprentices, Erie Railroad

[illegible] boys a [illegible] teach. A [illegible] Then let [illegible] all feel proud of, something of value to the com[illegible] something of value to himself.

In order to do this, the teacher will have to be somewhat of a psychologist. To be plain, he will have to work the apprentice boys into such a state of interest in what they are building that all other things are out of their minds. Then reveal what he has in store for them so strongly by a practical application, that they will always remember it.

I hear some of the old-time mechanics [illegible] just take the train to gay old New York City, and spruce up Broadway to Thirty-third street, where you can judge for yourself by looking in the Erie Railroad ticket window at [illegible] New York City [illegible]

[illegible] measures [illegible] complete with tender, only 60 pounds. It rests on [illegible] gauge. In other words, every inch on the large locomotive is represented by one-sixteenth of an inch on the model.

To give some idea of the size of this piece of work, the pins in the Baker valve gear run as small as one sixty-fourth of an inch in size, and the boys had to use needles to meet the hardened pin proposition.

The air hose was obtained from stripping No. 28 copper wire of its rubber in[illegible] can with what you have, where you are.

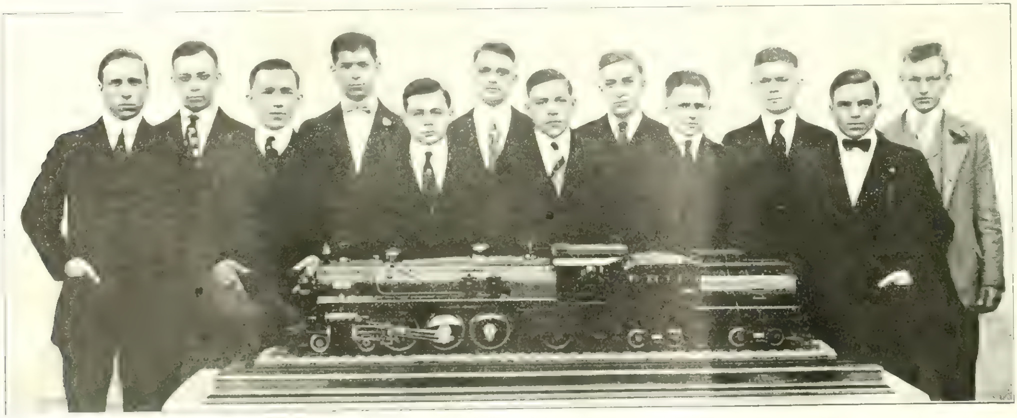
One apprentice boy was selected as a pace maker or general foreman. He in turn picked out two other apprentice boys, the best in the shop. The three foremen [illegible] and decided that the first thing to do was to build a small lathe, shaper and a motor to drive same; also a forge, cupola and a lot of small tools, as all work was to be done in the school.

Five boys were started under one foreman [illegible] drawing same. Later on these boys machined up the parts from castings made from patterns by other boys in the shop and in 90 days the school was transformed into a shop from pattern shop to the erecting shop.

In the meantime the other foreman was [illegible] with [illegible] drawings redrawn to one-sixteenth scale [illegible] model [illegible]. The pattern maker apprentices made patterns and core boxes from these drawings, and the foundry apprentices cast aluminum patterns and later made castings from same for the model locomotive.

[illegible] hundred days from the date of receiving the order to build, a young machine shop and [illegible] castings made in the school foundry to start work on the model locomotive was ready and in two hundred days from the time the order to build was received, the model was delivered to New York City.

This piece of work is sure to make the apprentices careful and good print readers, to say nothing about being good mechanics, they are able to double their earning capacity for they are of double value to their employer. True, they made a lot [illegible] and perhaps will in the future, but they profit by it every time, and each day sees some boy better than the average. Another working a little harder than the bunch and while they are all happy in their work, they are never satisfied with their work. Summed up, they are getting all out of the trade that there is in it.



[illegible] LOCOMOTIVE BUILT BY THE APPRENTICES IN [illegible] DUNMORE SHOPS, PA., ERIE RAILROAD SCALE [illegible] SIXTEENTH

[illegible] locomotive in running order, built at the Erie [illegible] in 200 [illegible]

If you have any mechanical sand in your dome, you will say it is "some job," and it is perfect in every detail from print to paint, but wait! here is the story of how it was built, entirely in the apprentice school.

The management of the Erie Railroad desired to test the apprentice boys in print reading, so it sent a shop order to [illegible] detail from prints furnished, same to be one-sixteenth scale, the entire locomotive [illegible] be placed on exhibition (after being in[illegible]

A boy's fitness for one part of the trade is his life's career, and he should be placed by the foreman where he can get the most work out of him, for shifting journeymen is a poor way to use up the company's money.

The apprenticeship system is working [illegible] well on the various railroads where they have a practical instructor who can throw out some inducement in order to bring in the boys from the outside, not from the street corners, but from the trade schools, and there is no place on a railroad where so small an outlay of money [illegible] such good results as in a properly run apprentice school, in which boys can make something worth while.

Repairing Air Pump Heads.

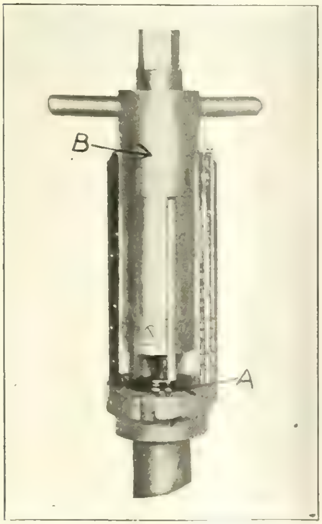
[illegible]

[illegible] ing up slightly worn reversing valve seats [illegible] pump.

[illegible]

[illegible] little [illegible] old valve [illegible] and used again. After removing the dowel the upper end [illegible] counterbored [illegible] any de- [illegible] the end of the valve travel, with a standard shell reamer working over a pilot, shown in Fig. 1.

Placing a 3/16-inch washer (A) Fig. 2, on the bottom of the bush, the distance



[illegible]

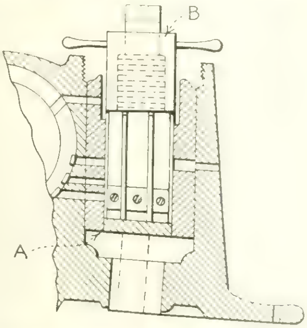
from the top of the washer [illegible] the lower end of counterbore will [illegible] the blades of an adjustable blade hand [illegible] whose blades are ground parallel [illegible] full length, a special adjusting [illegible] place of the standard nut, which permits of adjusting the blade while the reamer is in working position.

The irregular and worn condition of the valve seat causes the reamer to crowd over to that side of the bushing leaving the opposite side intact, which forms a guide, which insures the seat being left in proper alignment. Loosening the adjusting nut and tapping down the reamer the reamer body expands the blades. These conditions permit of a very fine adjustment. The whole operation consumes about ten [illegible]

Silencing Device for Holding Bell Clapper While Adjusting Ringer Engine.

[illegible]

During the operation [illegible] ringer engine on a [illegible]



SECTION [illegible] OF REAMER [illegible] ING POSITION

round-house it is generally advisable to muffle the bell for the comfort as well as the convenience of everyone in the vicinity of the locomotive. It is of course possible to muffle the bell by tying something over the clapper ball, but at that much time is frequently lost in securing something to secure to it. If the adjustment takes any length of time the clapper will pound to pieces almost anything that can be tied to it.

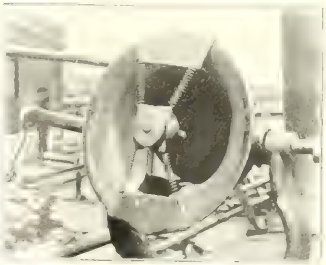
The reproduced photograph illustrates a very convenient jig or silencer that can be readily made and serves its purpose very well. The springs hold the clapper at all times from engaging the bell. One good feature about the arrangement is that it cannot be used for any other purpose, and if a place for it to be kept is designated in the roundhouse it will always be found there unless someone is using it. Burlap, canvas, etc., is often hard to immediately secure with which to muffle the clapper, but this little jig can be used only for this purpose and can always be found when its services are required.

Pop Testing Device in Operation at the Northfield Shops, Mo., of the St. Louis & San Francisco Railroad.

The accompanying illustration shows a Pop testing device used at the North [illegible]

[illegible]

[illegible] pump [illegible] bushed cylinder. The pops are all tested and set accurately before being applied to the engine, which saves considerable loss of time in adjusting after the engine is hot. The device has been in use for some time, and meets the approval of the mechanical department of St. Louis & San Francisco [illegible]



[illegible]

Black Varnish for Iron.

A good black varnish for castiron and [illegible] lampblack, half a pound resin, one pound asphaltum, one quart turpentine spirits, and a small quantity linseed oil. The lampblack is first rubbed up with the linseed oil, no more oil being used than necessary for this purpose. The other ingredients are then mixed with it thor- [illegible]

New Locomotives for the Burlington, the Colorado and Southern, and the Ft. Worth and Denver

The Chicago, Burlington & Quincy R. R. [illegible] has recently received 55 locomotives from the Baldwin Locomotive Works. Several designs are represented, as follows:

Fifteen Pacific type for passenger service.

Fifteen Mikado type for freight service.

Fifteen 2-10-2 type for freight service. Five of these will be used on the Colorado and Southern.

Ten Mikado type for freight service on the Ft. Worth and Denver.

Special interest centers about the Pacific type locomotives, which represent a new design; while the Mikado and 2-10-2 type locomotives are closely similar to engines previously built for this system. The Pacific type locomotives exert a tractive force of 42,200 pounds, and were designed to weigh approximately 170,000 pounds on driving-wheels, with a limit of [illegible] pounds on any one axle. Special attention has been given to the design of the reciprocating parts and other machinery details, with a view to reducing, as far as possible, the dynamic augment on the rail when running at high speeds. The locomotive throughout is an excellent example of a high-powered passenger engine, designed to develop maximum power in proportion to its weight, but in- [illegible] barrel is composed of three courses, the first course being sloped on top and the third course on the bottom. This con- [illegible] size, but it is well disposed and free [illegible] to crowd them at the expense of circulation. The [illegible] contains a brick-arch, which is supported on angle irons. The railroad company's standard [illegible] is applied, with four inlet tubes on each side of the [illegible]. The main dome, which is of pressed steel, is on the second boiler course. The auxiliary dome is on the third course, and is placed over a 16-inch opening in the shell so that the boiler can be easily entered for inspection purposes.

Mention has been made of the special attention given to the design of the reciprocating parts and machinery. The pistons have a dished section, and are of 40 per cent carbon cast steel, carefully annealed. They have iron bull rings cast on them. No extension rods are used, but the bull rings are widened, at the bottom, from $4\frac{1}{2}$ to 6 inches. The piston rods are of "nikrome" steel $4\frac{1}{4}$ inches in diameter, [illegible] They are forced into the heads under a pressure of 35 tons. The cross-heads are of the same material as the pistons; they are of the Laird type, with bronze gibs. The lug for the union link is cast in one piece with the cross-head body. The cross-head pins are of "nikrome" steel, [illegible] are also of "nikrome" steel, the main rods [illegible] adjustment. The front side rod tapers in depth from 5 inches at the front end to $6\frac{1}{2}$ inches at [illegible] knuckle pins are of "nikrome" steel, hollow bored. Walschaerts valve motion is used, and the gears are controlled by the Ragonnet power reverse mechanism.

As actually balanced, the dynamic augment [illegible] per cent [illegible] the static weight for the front and back driving-wheels, and 28 per cent for the main wheels. The proportion of the reciprocating weight that has been balanced is 61 per cent, and this is equivalent, on each side, to 1/202 of the total weight of the engine. The following actual weights are of interest in this connection:

Piston and rod complete, with cross-head key, 557 lbs.

Cross-head, 414 lbs.

Main rod, 870 lbs.

Side rod weight on front crank pin, 158 lbs.

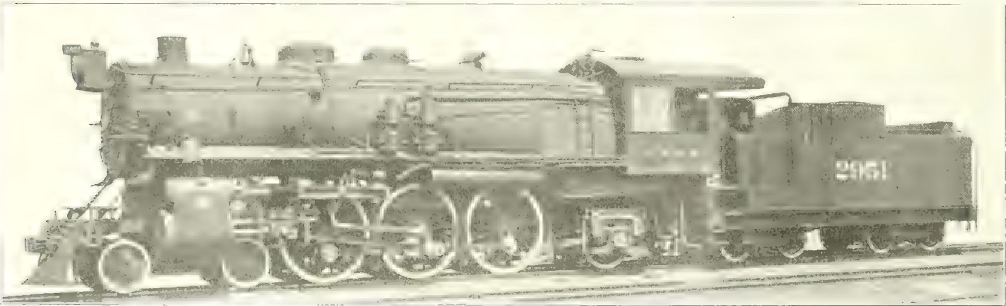
Side rod weight on main crank pin, 490 lbs.

Side rod weight on back crank pin, 168 lbs.

Crank pins complete, front, 125 lbs.

Crank pins complete, main, 295 lbs.

Crank pins complete, back, 130 lbs.



PACIFIC TYPE LOCOMOTIVE FOR THE CHICAGO, BURLINGTON & QUINCY RAILROAD [illegible]

[illegible] Baldwin Locomotive Works, Builders.

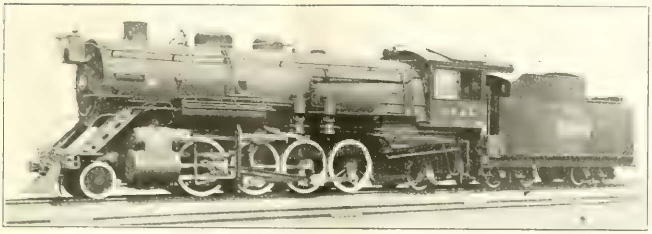
The cylinders are cast from the same pattern as those used on the Mikado type locomotives for the Fort Worth and Denver. They are fitted with vacuum relief valves, but no by-pass valves are used. The guide for the valve-stem cross-head is cast in one piece with the back steam-chest head.

The frames are of 40 per cent. carbon cast steel, annealed, and manufacured to specifications prepared by the American Society for Testing Materials. The main frames are six inches wide. The rear sections are of slab form, arranged to accommodate the Rushton type of trailing truck with outside journals. In the present example, the truck is fitted with three-point suspension links. The frames are braced transversely at the front and main driving pedestals, also by the guide yoke, valve motion bearer, and a waist-sheet cross-tie placed between the main and rear pairs of driving-wheels. At the splice between the main and rear frames is placed a strong transverse casting, which

contains a pocket for the rear truck radius-bar pin, and also supports the front of the firebox through a vertical expansion plate.

The pedestal shoes and wedges are of bronze. The driving-wheel centers are fitted with bronze hub plates, and the driving axles are of chrome-vanadium steel, heat treated and hollow bored.

The equalization system is cross-connected between the rear driving-wheels and trailing-truck. A central, vertical link, connects two transverse beams. The upper beam is suspended from the rear driving springs, while the lower beam is connected, by means of a vertical link on each side, with the rear truck equalizers. These are placed on an angle, so that they can connect with the truck spring hangers, which are placed outside the wheels. This construction, while maintaining the desired weight distribution between the driving-wheels and rear truck, prevents any rocking action on the part of the driving-springs from being transmitted to the truck springs, or vice versa. The locomotive should, therefore, prove a steady rider.



MIKADO TYPE LOCOMOTIVE FOR THE CHICAGO, BURLINGTON & QUINCY

The tender is equipped with a coal pusher, and is carried on equalized pedestal trucks. The wheels are of forged and rolled steel, manufactured by the Standard Steel Works Co.

These locomotives were designed by the builders, in consultation with Messrs. F. A. Torrey, Supt. of Motive Power, and C. B. Young, Mechanical Engineer of the railroad. The practice of the Burlington, as far as details are concerned, has been closely followed. The result is a locomotive which is specially fitted for the conditions to be met, and which has been designed, in the light of an unusually wide experience.

The principal dimensions of these locomotives, and also of the freight engines to which previous reference has been made, are as follows:

PACIFIC TYPE LOCOMOTIVE

Gauge, 4 ft. 8½ ins.; cylinders, 27 ins. by 28 ins.; valves, piston, 14 ins. diameter.

Boiler—Type, wagon-top; diameter, 78 ins.; Thickness of sheets, ¾ in. and 13/16 in.; Working pressure, 180 lbs.; fuel, soft coal; staying, radial.

Firebox—Material, st[illegible] ins.; width, 78¼ ins.; depth, front, 85¾ ins.; depth, back, 72 ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ⅝ in.

Water Space—Front, 6 ins.; sides, 6 ins. to 4 ins.; back, 4 ins.

Tubes—Material, Steel; diameter, 5½ ins. and 2¼ ins.; thickness, 5½ ins., No. 9 W. G.; thickness, 2¼ ins.; No. 11 W. G., number, 5½ ins., 34; 2¼ ins., 200; length, 18 ft. 6 ins.

Heating Surface—Firebox, 233 sq. ft.; combustion chamber, 59 sq. ft.; Tubes, 3,072 sq. ft.; Total, 3,364 sq. ft.; Grate area, 58.7 sq. ft.

Driving Wheels—Diameter, outside, 74 ins.; diameter, center, 66 ins.; journals, main, 11 ins. by 12 ins.; journals, others, 10 ins. by 12 ins.

Engine Truck Wheels—Diameter, front, 37 ins.; journals, 6 ins. by 12 ins.; diameter, back, 48¼ ins.; journals, 8 ins. by 14 ins.

Wheel Base—Driving, 13 ft.; rigid, 13 ft.; total engine, 33 ft. 8 ins.; total engine and tender, [illegible]

Weight—On driving wheels, 169,700 lbs.; on truck, front, 47,800 lbs.; on truck, back, 48,900 lbs.; total engine, 266,400 lbs.; total engine and tender, about 425,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 37 ins.; journals, 5½ ins. by 10 ins.; tank capacity, 8,200 gals.; fuel capacity, 13 tons; service, passenger.

Engine equipped with Schmidt superheater.

Superheating surface, 751 sq. ft.

MIKADO TYPE LOCOMOTIVE

[illegible]

Gauge—4 ft. 8½ ins.; cylinders, 28 ins. by 32 ins.; valves, piston, 14 ins. diameter.

Boiler—Type, straight; diameter, [illegible] ins.; thickness of sheets, ⅞ in.; working pressure, 180 lbs.; fuel, soft coal; staying, radial.

Firebox—Material, steel; length, 117 ins.; width, 96 ins.; depth, front, 91½ ins.; depth, back, 76¼ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ⅝ in.

Water Space—Front, 6 ins.; sides, 6 ins. to 4 ins.; back, 4 ins.

Tubes—Material, steel; diameter, 5½ ins. and 2¼ ins.; thickness, 5½ ins., No 9 W. G.; thickness, 2¼ ins., No. 11 W. G.; number, 5½ ins., 45; 2¼ ins., 264; length, 18 ft. 7¼ ins.

Heating Surface—Firebox, 277 sq. ft.; combustion chamber, 69 sq. ft.; tubes, 4,080 sq. ft.; fire-brick tubes, 39 sq. ft.; total, 4,465 sq. ft.; grate area, 78 sq. ft.

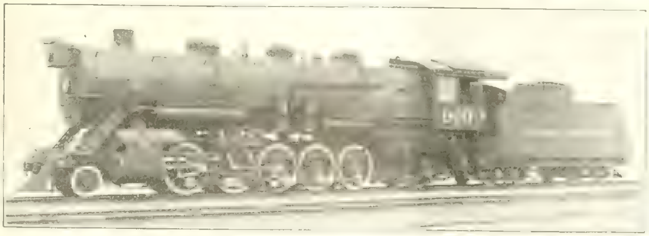
Driving Wheels—Diameter, outside, 64 ins.; diameter, center, 56 ins.; journals, main, 11 ins. by 12 ins.; journals, others, 10 ins. by 12 ins.

Engine Truck Wheels—Diameter, front, 37 ins.; journals, 6 ins. by 10 ins.; diameter, back, 42½ ins.; journals, 8 ins. by [illegible]

Wheel Base—Driving, 16 ft. 9 ins.; rigid, 16 ft. 9 ins.; total engine, 35 ft. 9 ins.; total engine and tender, 67 ft. 6¼ ins.

Weight—On driving wheels, 239,900 lbs.; on truck, front, 28,000 lbs.; on truck, back, 47,500 lbs.; total engine, 315,400 lbs.; total engine and tender, 497,500 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. by 10 ins.; tank capacity, 9,200 gals.; fuel capacity, 20 tons; service, freight.



[illegible] TYPE LOCOMOTIVE [illegible]

Engine equipped with Schmidt superheater.

Superheating surface, 1,005 sq. ft.

[illegible] TYPE LOCOMOTIVE

Gauge, 4 ft. 8½ ins.; cylinders, 30 ins. by 32 ins.; valves, piston, 15 ins. diameter.

Boiler—Type, [illegible] ins.; thickness of sheets, ⅞ ins.; working pressure, 175 lbs.; fuel, soft coal; staying, [illegible]

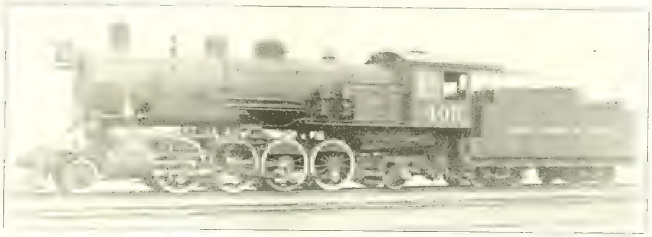
Firebox—Material, steel; length, 132 ins.; width, 96 ins.; depth, front, 89¾ ins.; [illegible] sides, ⅜ in.; thickness of sheets, back, ⅜ [illegible] thickness of sheets, tube, ⅝ in.

sides, ...

...meter, 5 ins. and 2¼ ins.; thickness, 5½ ins., No. 9 W. G.; thickness, 2¼ ins., No. 11 W. G., ... length ...

Heating Surface—Firebox, 272 sq. ft.; combustion chamber, 68 sq. ft.; tubes, 4,966 sq. ft.; fire-brick tubes, 43 sq. ft.; total, 5,349 sq. ft.; grate area, 88 sq. ft.

Driving Wheels—Diameter, outside, 60 ... journals, others, 11 ins. by 12 ins.



... LOCOMOTIVE FOR THE FORT WORTH & DENVER ...

Engine Truck Wheels—Diameter, front, 34 ins.; journals, 6 ins. by 10 ins.; diameter, ... journals, 8 ins. ...

Wheel Base—Driving, 20 ft. 9 ins.; ... 40 ft. 1 in. ...

Weight—On driving wheels, 295,950 lbs.; on truck, front, 25,200 lbs.; on truck, back, 46,700 lbs.; total engine, 367,850 lbs.; total, engine and tender, 562,000 lbs.

Tender—Wheels, number 8; wheels, diameter, 34 ins.; journals, 6 ins. by 11 ins.; tank capacity, 10,000 gals.; fuel capacity, 20.8 tons.; service, freight.

Engine equipped with Schmidt superheater.

Superheating surface, 1,232 sq. ft.

... THE FORT ...

Gauge, 4 ft. 8½ ins.; cylinders, 27 ins. by 30 ins.; valves, piston, 14 ins. diameter.

Boiler—Type, wagon top; diameter, 78 ins.; thickness of sheets, ¾ in. and 13-16 in.; working pressure, 180 lbs.; fuel, oil; staying, radial.

Firebox—Material, Steel; length, 108⅛ ... thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

... ins. to 4 ins.; back, 4 ins.

Tubes—Material, steel; diameter, 5½ ins. and 2¼ ins.; thickness, 5½ ins., No. 9 W. G.; thickness, 2¼ ins., No. 11 W. G.; ...

... 3488 sq. ft.; total 3,703 sq. ft.; grate area, 54.2 sq. ft.

Driving Wheels—Diameter outside, 64 ins.; diameter, center, 56 ins.; journals, main, 11 ins. by 12 ins.; journals, others, 10 ins. by 12 ins.

Engine Truck Wheels—Diameter front, 37 ins.; journals, 6 ins. by 10 ins.; diameter, back, 42½ ins.; journals, 8 ins. by 14 ins.

Wheel Base—Driving, 16 ft. 9 ins.; rigid, 16 ft. 9 ins.; total engine, 33 ft. 9½ ins.; ...

Weight—On driving wheels, 213,150 lbs.; on truck, front, 25,500 lbs.; on truck, back, 34,200 lbs.; total engine, 272,850 lbs.; total engine and tender, 434,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5½ ins. by 10 ins.; tank capacity, water 8,200 gal.; tank capacity, oil, 3,050 gals.; service, freight.

Engine equipped with Schmidt superheater.

Superheating surface, 834 sq. ft.

Operation of Freight Trains on Lehigh Valley.

Two hundred and eighty-nine regular freight trains operated by the Lehigh Valley Railroad made a record of ... on time 98.4 per cent. during the month of March, according to an announcement just made by the management. Eight daily through freight trains leaving either Jersey City or Buffalo, arrived at their terminals every day during March either ahead or exactly on time. Two daily trains carrying shipments to points west of Buffalo were on time every day during the month, and delivery to connecting lines there was made on time on all but ... occasions. In each case this was due to unusual conditions at the delivery point, but the delay ... interfere with the service, all connections being made and no shipments being held up.

Central Shops of the Chilean Railways.

The construction of the proposed railway shops must be considered as one of great importance. The necessary land has been purchased ... San ... at a cost of $...000 United States gold. The shops and associated installation will probably cost about $3,650,000 and will contain everything required for handling the work of the Chilean railways, regardless of any ... growth they may have.

The work should be started at the earliest possible moment as it will be a long job, and already there is an enormous amount of work to be done in the general repair required by all the equipment. Actually, according to the statement of railway officials, 20 per cent. of the rolling stock is always awaiting repair, when there should not be more than 8 or 10 per cent. in that condition. It is proposed to spend $$271,000 for new locomotives and $12,000 for ballast cars, without mentioning freight cars, of which there is an ample supply if they could ... be repaired.

Ten locomotives have been contracted for delivery this year, which are to be built by two Valparaiso firms; and if the new shops were in readiness such orders could be filled there, as also the 70 ballast cars which the Directing Council of Railways has approved for later purchase.

Canadian Railway Development.

The formal opening of the Coast-to-Kootenay service of the Kettle Valley Railway has been celebrated at Penticton, British Columbia. The railway now completed through Southern British Columbia materially shortens the distance between the coast cities and interior points. The company, a subsidiary of one of the Canadian Pacific Railway, started work in 1910, and the first grading of the line was done on the Merritt end in July, 1910. Penticton, situated about midway between Vancouver and Nelson, is expected to be one of the largest towns in the Okanagan Valley. It has a population of about 3,000, and, situated at the foot of Okanagan Lake, is a tourist resort practically all the year. Midway, the terminus of the Crow's Nest line and of the Kettle Valley Railway, is situated on the Kettle river, and with the advent of the railway its agricultural development is going ahead rapidly.

Railways in Argentina.

The Administrator General of State Railways reports that the branch line from ... to Oran, in the Province of Salta, near the Bolivian frontier, is nearing completion and will be opened to traffic in about two months. It is stated that as soon as work on this branch is terminated the construction of the line from San Juan to Jachal will be commenced. This line, 112 miles long, has been planned for some time and is much needed to further the development of the northern part of the Province of San Juan.

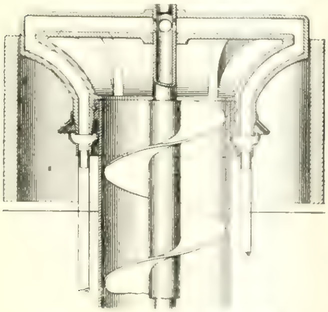
Recent Interesting Inventions

Rotating Mechanical Stoker, and Improved Piston Packing

Rotating Mechanical Stoker.

A rotating mechanical stoker, the invention of Mr. S. H. Dunning, Paterson, N. J., has already attracted considerable attention on account of the novel feature it presents, particularly in the part known as the spreader, which, as shown in the accompanying illustration, is designed to be located at the top or upper end of a screw conveyor which passes through the grates, the conveyor revolving in a cylindrical casing secured to a rotating shaft, the fuel in a pulverized condition being conveyed through the cylindrical casing until it is fed or deposited into the flange or shelf of the spreader, which has the form of an inverted hollow truncated cone, the circular wall of which is hollow to form a water chamber, the upper and outer flaring edge having integrally formed therewith two cross-arms connected to pipes through which is permitted a continuous [illegible] circulation of water in and around the parts of the spreader, thereby overcoming the danger of the parts being injured by the heat in the firebox.

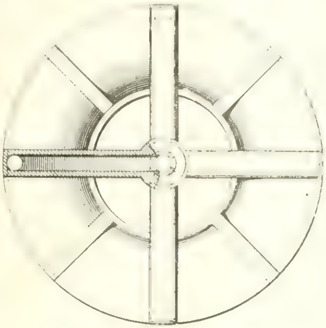
The proper spreading of fuel is accomplished by ribs or flanges gradually increasing in height from their lower ends to about the center of their length, their particular formation having the effect of throwing or spreading the coal evenly over the fire-bed, the rotating screen conveyor, driven by simple mechanism, carries the fuel upwardly until it is fed into the upwardly flaring wall of the rotating spreader, which in turn carries it upwardly, and with a tendency to spread it, the fuel being carried in a circular path by the hollow ribs or flanges, the result



SECTION OF ROTATING [illegible]

being that the material is evenly spread a distance in accordance with the rate of speed at which the spreader is rotated.

It will thus be seen that the device is simple in construction. The necessary mechanism to supply the [illegible] the conveyor, and the motion to the spreader, as well as the circulation of the water for cooling, is also simple, consisting of a single shafting to which bevelled pinions are mitered to corresponding pinions conveying the movement to the various parts,



PLAN OF ROTATING SPREADER

the whole forming a compact and easily constructed appliance, which in point of economy should attract favorable consideration.

Improved Piston Packing.

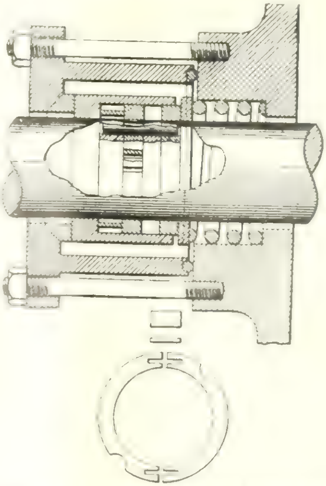
Mr. Thomas Smith, an American engineer resident in San Luis Potosi, Mexico, has perfected an improvement in piston packing which is favorably [illegible] among railroad men. As shown in the accompanying illustration the packing takes the usual form of segmental rings surrounding the reciprocating element and having a curved external seat; a cup surrounding the ring, and having a curved internal leak, in addition to which there is a cylindrical key lodged in the seats and means for limiting the movement of the cup longitudinally of the reciprocating element. It will be observed in the lower portion of the illustration that the segmental parts of the packing are spaced apart slightly, and that the adjacent ends of the parts of the ring are equipped with rectangular seats adapted to receive bridges having ribs which register in longitudinal slots in the cup. The keys in peripheral outline conform closely to the seats in the cup, but fit somewhat loosely in the seats of the ring parts. The cylindrical keys which are about one sixteenth of an inch less than the combined width of the secondary rings are mounted in the seats of the rings and in the seats of the cup. The result is that with this attachment the rings cannot rotate to any appreciable extent within the cup, and consequently, the segmental parts of the several rings will be held out of alinement and there will be [illegible] continuous [illegible] the rings, through which fluid pressure [illegible].

It will thus be noted that the object of this improvement in piston packing is to provide means for holding the segmental rings against rotation, thereby maintaining the spaces between the adjacent ends of the packing rings.

It may be added that the method of piston packing has been already tested with good results.

Brazing Fluxes.

A fluxing composition for brazing cast iron to cast iron, wrought iron, or cast steel, consists of a plastic composition or paste formed by mixing powdered steel or iron, borax, and oil not containing resin or acid such as cocoanut-oil, paraffin-oil, or vaseline, and methylated spirits, preferably in the proportion of 60 parts of steel, 20 parts of borax, and 10 parts each of oil and spirits. The composition may be restored to its plastic condition, if it hardens after keeping, by the addition of a small quantity of methylated spirits. In applying the composition, the articles are cleaned by a stiff wire brush and water, after first, if necessary, using spirits of salts, and the composition then applied, and the articles clamped together. The joint is



[illegible] IMPROVED PISTON PACKING

surrounded by borax, and the articles heated in a furnace or charcoal fire or blue burner. The joint is sprayed with spelter and then covered with curved sheet iron to retain the heat. Borax is then applied to promote free fusion. The article is removed after cooling.

Catechism of Railroad Operation

Locating Pounds and Keying Up Rods, and Disconnecting for Broken Rods and Levers

[illegible]

Third Year's Examination.

[illegible] 231 [illegible] 1915

Q. 208.—[illegible] what [illegible] is it necessary to take down the main rod? The side rod?

A.—Take down the main rod for any accident that affects the free action of the main rod or its reciprocating connections and supports. Take down the side rod for any accident that affects the side rod, its supports or the corresponding side rod.

Q. 209.—If it is not necessary to take down the main rod on disabled side of the engine, how would you arrange to lubricate the cylinders?

A.—There are several methods; the most approved method is—block the back admission port slightly open and with cylinder cock removed establish a circulation of steam through back end of cylinder and distribute lubrication to piston rod as well as walls of cylinder. Another way—remove indicator plugs and oil through the openings. Another method: Loosen front cylinder head and put in a wooden wedge at top, then oil through the opening. Another way: remove front cylinder head. Put swab of waste well saturated with oil in cylinder, then replace head or board up front end of cylinder.

Q. 210.—[illegible] up for a broken driving spring, spring hanger or equalizer on the different classes of engines now on this road.

A.—Run the wheel ahead or back of the disabled spring up on wedge, block over [illegible] wheel, then run the wheel at disabled spring up on wedge and block above or below ends of equalizers or intermediate springs as is necessary.

Q. 211.—[illegible] slip badly and be unable to start train when on [illegible]

A.—On the left side.

Q. 212.—If a throttle valve were closed [illegible] what might be the cause?

A.—A leaky throttle on dry pipe.

[illegible] moved if the reversing lever or reach rod were caught at a short cut off by a broken [illegible]

A.—Disconnect forward end of reach rod and let links down on link blocks. [illegible] ahead, run front driver up on wedge and block top of back driving box under frame, run over block and run back driver up on block and block on top of forward driving box under frame and repeat this process until engine is up level, then you can remove the broken parts and connect up the reach rod and proceed.

Q. 214.—When should you report crossheads to be re-babbited, or guides to be closed?

A.—Report crossheads re-babbitted when all babbitt is worn or broken off and iron is wearing on iron. Report guides closed when crosshead pounds.

Q. 215.—When should driving box wedges be reported to be lined?

A.—When the wedge has been set up as far as it can go and box still pounds.

Q. 216.—When should rod brasses be reported to be closed. To be lined?

A.—Rod brasses should be closed when keyed as closely as possible and they still pound on pin. They should be lined when key is set up as far as possible and brasses are loose in strap and pounding on pin.

Q. 217.—In case your engine started to pound in cylinder after shutting off steam, what would you do to prevent damage to cylinder?

A.—Open throttle and cushion the piston.

Q. 218.—What is a good method of raising engine to block up when jacks are not available?

A.—Snubs or wedges.

Q. 219.—What is a balanced slide valve?

A.—[illegible] surface.

Q. 220.—Where is the piston rod packing located?

A.—Around piston rod in the gland and [illegible] head.

Q. 221.—Where are piston packing rings [illegible]

A.—In grooves cut in the outer surface of piston head and they make a steam tight fit with walls of cylinder.

Q. 222.—What would you do if back cylinder head broke?

A.—That would depend on conditions. Disconnect valve rod, block valve centrally on seat, provide for lubrication and free circulation. Note: If guides were damaged would have to disconnect main rod, put collar on main pin, secure crosshead ahead, with chain around body of cylinder after clamping valve on center of seat and disconnecting valve rod.

Q. 223.—What would you do if driving box was running very hot and would not cool down with lubrication?

A.—Relieve the weight on box by running disabled wheel on wedge and blocking between spring saddle and frame. Note:—Where arch equalizers are used, block between ends of equalizers and lower frame rail to hold them up off box.

Q. 224.—What would you do if gib was lost out of crosshead?

A.—Substitute piece of hard wood. Note:—The greatest strain comes on top guide bar when going ahead, and piston [illegible] would be liable to [illegible] if the gib was not replaced.

Q. 225.—What different methods are there of getting valve centrally on seat?

A.—(1) Get center line of rocker arm at right angles to valve rod. On Walschaerts gear put link block in center of link and get the center line of combination lever at right angles to valve rod.

(2) Place engine on quarter and reverse lever in center of rack.

(3) Disconnect valve rod and move valve ahead in chest, open cylinder cocks, admit steam and pull valve back till steam ceases to flow at back cylinder cock. Mark valve stem at gland's face and pull it back about $\frac{3}{4}$ to $\frac{7}{8}$ of an inch.

Q. 226.—How do you block back admission port slightly open for lubricating cylinder and piston rod?

A.—Disconnect valve rod and pull valve back in chest. Open cylinder cocks, admit steam and move valve ahead slowly until a little steam shows at back cylinder cock.

Q. 227.—What is the purpose of counter bore in cylinder and grooves across guide bars near ends?

A.—To prevent wearing a shoulder.

Q. 228.—What are the vertical marks, paralleling each other near each end of guide bars on outside?

A.—The one farthest ahead and back are striking points, that is, point reached by crosshead in guides when piston head will strike cylinder heads. The two inner marks are to indicate points reached by crosshead in guides when main rods are the proper length. They are sometimes called clearance marks.

Q. 229.—[illegible] whether main rod was too long or too [illegible]

A.—[illegible] striking points marked on guide bars when en[illegible]

Q. 230.—How would you shorten main rod that was too long? How lengthen one that was too short?

A.—By taking liners from in front of brasses at main pin and putting them in back of the brasses the rod is shortened. By taking liners from strap back of brasses at main pin and putting them in ahead of the brasses, rod is lengthened.

Q. 231.—What [illegible] lost off [illegible]

A.—Take nut off the other main pin and put it on where nuts were gone, then secure nuts on both main pins by winding

wire in threads [illegible] threads a little.

Q. 232.—What should be done if cylinder [illegible]

A.—[illegible] with piece of sheet iron and drive tight, or could drive it out far enough to sprinkle a little sand alongside of it and drive it back. If lost replace with wedge of iron or use Christie brake shoe keys to fill in and wedge cylinder tight. Note:—If could not replace, would have to disconnect that side of engine.

Q. 233.—How can an engine be brought in with broken front end or stack?

A.—Board up front end or cover with canvas. Use barrel for stack or raise draft [illegible]

Questions Answered

[illegible]

L. F. K., Lansing, Mich., writes: "Will you please explain why the balanced piston valves are not used on the Stanley steam motor instead of the plain slide valves." A. The reason that slide valves are used is because they give the best results in the hands of the users of those cars, who, in most cases, are not engineers or even mechanics. The slide valve, in case there is water in the cylinder, will lift and allow the water to escape usually without any damage to the engine. Piston valves have been tried and found to be impracticable, because sooner or later a cylinder would be knocked out or a crank or connecting rod bent, caused by water in the cylinders.

[illegible]

C. F. S., St. Louis, Mo., asks: A locomotive of the 0-6-0 type, weight 69 tons, cylinders 20 by 26 inches, steam pressure 200 pounds. Weight of engine and tender 120 tons. How many tons will this locomotive haul up a grade 80 feet per mile, [illegible]

A.—The total weight on the driving wheels, 138,000 pounds, would limit the hauling capacity to 32,000 pounds. The resistance of the locomotive and tender would be about 2,000 pounds, leaving 30,000 pounds of tractive force for moving the train. If the steepness of the grade in feet is multiplied by 0.38 the product will be the resistance in pounds per ton. Hence, 80 × 0.38 = 30.4, the number of pounds per ton for that amount of grade. The allowance generally made for the [illegible] each degree of curve. Hence, 6 × 1½ = 9, the number of pounds per ton on account of curve. The resistance for loaded freight cars at a speed of less than 10 miles per hour, will not be less than 4 pounds per ton. Hence, 30.4 + 9 + 4 = 43.4 pounds per ton. Therefore, 30,000 ÷ 43.4 [illegible]

COUNTERBALANCING [illegible]

W. De H., Louisville, Ky., writes: Kindly furnish the rule for counterbalancing. The locomotive is of the 2-6-0 type, cylinders 18 by 26 inches, wheels 63 inches in diameter, 165 pounds steam pressure. Running in passenger service from 45 to 55 miles per hour.

A.—There is no established rule in general use for counterbalancing. The matter has engaged the attention of many leading engineers for a number of years, and considerable progress has been made looking towards a solution of the problem. At the last annual Convention of the American Railway Master Mechanics' Association, a Special Committee expressed in general terms a counterbalancing rule which should give good results, when applied to any class of locomotives in any service. A recommendation was made to keep the total weight of the reciprocating parts on each side of the locomotive below 1/160th of the part of the total weight of the locomotive in working order, and, then balance one-half the weight of the reciprocating parts. In the June issue of RAILWAY AND LOCOMOTIVE ENGINEERING the present year we published a lengthy editorial on the subject of "Counterbalancing Locomotive Driving Wheels," which has been favorably commented on by excellent authorities, and which fully reflects the present status of the question.

TWO AND THREE CYLINDER [illegible]

W. H. B., Leeds, England, writes: An engine has three high-pressure cylinders, diameter 16½ inches, stroke 26 inches; boiler pressure 160 pounds. Another engine has two high pressure cylinders, 20 inches by 26 inches, boiler pressure 160 pounds. The three-cylinder engine has the cranks set 120 degrees apart. The two-cylinder engine has the cranks at 90 degrees apart. The diameter of driving wheels of both engines is 6 feet. Which of the two engines should be the stronger in making a start with a load?

A.—The variation in power, if the weight on the driving wheels is alike in both cases, would be slightly in favor of the engine equipped with three cylinders, the difference being in the ratio of the square of the diameter of the cylinders. In the case of the three cylindered engine, [illegible] of the two-cylinder engine the calculation would be [illegible]

[illegible]

A. B., Youngstown, O., writes: "Can the Westinghouse E. T. brake get into such a condition that the brakes are apparently operating correctly but occasionally the independent brake fails to apply either in slow or quick application position, the reducing valve carrying 45 lbs. pressure?" A. Yes, although it is not due to any particularly defective condition of the brake. If the application cylinder pipe and the release pipe are wrongly connected or "crossed" at the distributing valve, the brake may act as you mention, that is, the independent brake applies and releases as long as the equalizing valve of the distributing valve remains in its release position, but if it is moved to lap position from slight brake pipe leakage that is not promptly supplied by the feed valve or that cannot be supplied because of a slight overcharge of the brake pipe by a movement of the automatic valve to release position, an attempt to apply the independent brake at such a time will fail because the equalizing slide valve will lap the release pipe port through which pressure from the independent valve must pass to the application cylinder when the pipes happen to be wrongly connected. A test for such a disorder is to apply the brake with the automatic valve, and if the brake cannot be released with the independent valve while the automatic is on lap, but can be released when the automatic valve is in holding position, it indicates that the pipes are wrongly connected.

[illegible]

H. E. H., Mahanoy City, Pa., writes: Describe the method of locating a broken valve, valve-yoke, or valve stem broken inside the steam chest, and what should be done after locating the breakage.

A. The irregular exhaust of the steam will indicate that there is some defect, and the engine should be moved until a crank-pin is placed at the dead center, and the throttle valve can be opened, and also the cylinder cocks. The reverse lever should then be moved forward and backward. If the valve stem or valve yoke is broken the valve will not be moved and the escape of steam will be constant. Both sides of the engine should be tried and the defect located and if the break is inside the steam chest the cover must be removed and the valve secured in a central position with blocking or otherwise. The opening for the valve-stem may be closed with a wooden plug.

Hardening Cold Chisels.

When the chisel has been hammered to the proper shape, take the chisel, and, after having ground to required edge, heat to a dull cherry red, and plunge into cold water; this makes it hard. Now heat a piece of iron to a dull red, and, after having cleaned chisel on one side, and polished with emery cloth, lay the chisel down on the hot iron, polished side up. Now watch the colors creep over the surface of the polish, and when the dark straw appears along the sharp edge of the chisel quench at once. Of course, a great deal depends, as may be readily understood, on the steel the chisel is made of.

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Speed of Locomotives.

[illegible] nearly all the beasts of the field and of [illegible] Man's own capacity for speed is remarkably limited, but with powe[illegible] animals and all forces except the electric spark. The locomotive had no [illegible] condition, when railway men and others proceeded to demonstrate its speed capacity. For years no particular attention was directed to the haul[illegible] pioneer journals devoted to railway [illegible] the extraordinary speed attained by certain locomotives.

There seems to have been a mania [illegible] propensity towards building locomotives capable of maintaining speed of not less than a mile a minute [illegible] where the track was not safe to carry trains running at half the speed named. "A mile a minute" [illegible] remembered, and for a few years was a sort of shibboleth with locomotive designers. They built the high speed engines and were proud of their enterprise until they learned in a most impressive manner that they were blundering, for it was proved beyond explanation that the boilers would not generate the steam necessary to keep the wheels turning. The pioneer locomotive designers concluded in the first place that the most important element of high speed was large driving wheels, which were supplied. To revolve huge driving wheels, large cylinders were necessary, and these were put in so liberally that a few charges of steam emptied the small boilers that were not so very much larger than the [illegible]. Experience [illegible] needed [illegible] the parts of a locomotive. This par[illegible] construction [illegible] expensive to railway companies, but it had to be attended to.

The first master mechanics had only theory and good sense to guide them in their early designs, and a natural line of reasoning was, that large driving wheels operated by large cylinders would produce a good working locomo[illegible] proper proportions. The best length of stroke in relation to cylinder [illegible] question in [illegible]

Two of the most celebrated pioneer master mechanics were Robert L. Ste[illegible] [illegible] locomotives brought out by these me[illegible] thing not to be wondered at. [illegible] 96 inch diameter. To remedy the want of tractive power, the next engine built under [illegible] the same [illegible] long stroke did not produce a successful locomotive, but it acted as a caution [illegible] the longest stroke ever used.

In following the tendency of locomotive designing, we find that the diameter of driving wheels gradually de[illegible] inches became the favorite, and per[illegible] very successful locomotives with that size of driver being in service today. The most influential move towards modern designing was represented in two locomotives built by William Norris for the Erie Railroad, with cylinders 14 x 32 inches. These engines became famous for their excellent performance and many railroads began to demand duplicates.

The proportions of grate area to boiler heating surface and the proportion of heating surface to cylinder content with the weight and power were all established by a tentative process. Certain builders turned out engines of certain proportions that met with popular judgment and prejudices which were accepted as being correct. Ability in designing was less apparent than good luck, and, in many cases, persistent advertising. In whatever manner its form and proportions may have been developed, the American locomotive stands second to none with the people interested in moving passengers and freight expeditiously at low cost.

Carbon As a Life Creator.

Carbon, in the [illegible] is more familiar to the majority of our readers than any substance except water and the elements of food. The manifestations of carbon and its compounds that produce heat and combustion are more useful to mankind than any other substance. A new attribute has lately been claimed for carbon, viz., that it is the creator of life. Scientists who have given the action and efforts of nature's elements have decided that no element has so much influence on the production and sustenance of life as carbon and its compounds.

Details of the discoveries made by scientific experiment [illegible] that carbon possesses the power of linking its atoms together in large and complex groups, and that these groups are able to assimilate the molecules of certain other atoms. The larger these loose mobile groups grow, the more power they acquire. So long as their structure is not dissolved by too great a heat or solidified by intense cold, they become the vehicle for influencing minute cells with acquire a power entirely novel and unexpected.

The complexes group themselves into [illegible] cells [illegible] with [illegible] ganic portions. Thus there begins the act of "feeding." [illegible] similation need not remain entire, but may split into two or more cells. Thus begins the act of reproduction, which is very mysterious when examined in detail, but it [illegible] scientists, in the most stupendous act [illegible]

Board of Inventions and Developments.

It is a hopeful sign of the times when a department of the government asks the aid of the leading inventors to meet the new conditions that confront the common defence of the country in case of becoming embroiled in war. History furnishes proofs of the value of inventions in times of peril and the establishment of permanent Bureau of Invention and Development is something that might have been thought of before, and it will be to the credit of the present government if the proposition is firmly settled as one of the subsidiary branches of the government. The scope and plan of the movement are well laid out by the Secretary of the Navy in a statement inviting Thomas A. Edison to join the new board, in which he says: "One of the imperative needs of the navy, in my judgment, is machinery and facilities for utilizing the national inventive genius of Americans to meet the new conditions of warfare as shown abroad, and it is my intention if a practical way can be worked out, as I think it can be, to establish at the earliest moment a Department of Invention and Development to which all ideas and suggestions either from the service or from civilian inventors can be referred for determination as to whether they contain practical suggestions for us to take up and perfect. We, of course, receive many suggestions, but our only way of handling them at present is to leave them to various bureaus already overcrowded with routine work, and it is not always possible to give the necessary attention to propositions that are not so definitely worked out as to make them immediately available for the service."

Such governmental appreciation and encouragement will do much to promote inventions. Hitherto comparatively little inventive thought has been attracted by governmental requirements. The path of the inventor is one on which progress is possible only over a long series of discouraging failures. He is of the pioneer class and, like other pioneers, the fruits of whose struggles have added so materially to the civilization of the world, his labors and aim should be better appreciated. With the establishment of the proposed new Bureau, a supervision of inventions will be made that should go a long way to encourage real merit.

The resources of this country are so vast that we can make anything we need very quickly, but manufacturers must have plans and specifications from which to work and the experimental stage should be surmounted as soon as possible. Hundreds of inventors will submit plans and new ideas to the Board as soon as they know what is required, and from the mass of suggestions it may be relied upon that much of real value will come.

It has been suggested from time to time that something of this kind should be established in connection with the railways. As is well known the introduction of any new appliance in railroad work is fraught with much difficulty. The inventor who hopes to add some new devise in the department of railroad work must needs have a patience that never wearies, an earnestness that defies discouragement and also a command of means to further the introduction of his appliance. A Board similar to the one suggested by the Secretary of the Navy would avoid all this, and a judgment could be furnished expeditiously in regard to the merit of new devices that could not fail to be generally received as based upon a justness of discrimination of the propositions submitted.

The Atom in Combustion.

Observers of the [illegible] seldom realize the complex [illegible] of the gases that form flame. Dr. [illegible] and Waldo, in discussing a paper on Liquid Fuel, made some remarks that are highly edifying to people interested in combustion. He said:

"When Newton began his experiments with thin films of soap bubbles and their molecular break-up and the transmission of light [illegible] around the so-called 'atomized' watery vapor, a new science was born, and some of the most beautiful molecular theories have grown out of the 'atomization' of oil and other liquids. Professor Millikan has published [illegible] chemical researches in which he analyses single drops of oil, atomized them and then taking a single atomized particle in a dark chamber he makes it drop between powerful electrical excited films and watches the action of these minute particles. He found that it was imbued with activity and life, darting hither and thither, influenced by the force of the magnetic field.

"In the modern burner we have, you know, the little atomized particle of oil which has got to find somewhere two particles of oxygen. It has to find it in a mass of nitrogen and other gases, and the velocity of these particles of oxygen amounts to 1,600 feet per second, a little less than the velocity of a shell from a ten-inch breach loading rifle in naval practice, we will say. Now, it is necessary that this particle shall have plenty of room in which to find its mates. Out of that has grown the combustion chamber and the Best burner, which is a great advance over the older forms of burners. For the best combustion there [illegible] immaterial. It may be flat as in the case of the Diesel engine at the end of the cylinder, or it may be oblong, but the volume must be there and time must be given. Time is equally important with the question of size to which these small particles of oil are reduced before sent to find their mates. [illegible] the combustion will also be imperfect. [illegible] theory of atomized oil burning, the whole problem of atomized oil burning rests in the size of the 'atoms,' the duration and in the limiting space the combustion takes and in the heat by which the thing is surrounded; and as these things increase they follow efficiency and make the modern oil burner possible."

In studying out these mysteries of combustion as explained by Dr. Waldo, we should not forget the immense pains-taking labor spent by the various scientists who have given the world information concerning the operations that are carrying along the wheels of progress and working out the triumphs of our industrial life.

The Piston.

The piston was the element that first made the steam engine successful, yet inventors were a long time in realizing that a disk of metal working in a steam-tight cylinder was the proper way to harness the elastic power of steam to convert it into useful work. Yet the piston had been tried many times hundreds of years before Newcomen made his engine a success by using the piston. There lived in Alexandria about 2,100 years ago a philosopher named Hero, who published a treatise on pneumatics which contained descriptions of a great many engineering devices that had been invented for water raising and other purposes. Among the inventions he described was a piston working in a cylinder. Many years later the piston was used as a plunger of a water pump and it became popular for that purpose, but in such cases it was driven by outward power and it took a long time for inventors to perceive that it might be [illegible]

The first philosopher to propose the use of a piston to transmit power was Jean Hautefeuille, a French priest of inventive tendencies. Among other power engines, in 1678, he proposed one with a piston to be driven by charges of gunpowder. There is no record that such an engine was ever built, but the idea took root. It will thus be seen that the first proposal to use a piston for power pur- [illegible]

[illegible] a Dutch Philosopher, who in [illegible]

[illegible] the necessity for the steam [illegible] was [illegible] very urgent in Great Britain, as great mining properties were going to ruin through the [illegible] power for the pumping of deep mines. [illegible] to apply steam to raising water by direct pressure as water is raised by air pressure in sleeping cars; and sometimes by suction into a vacuum created by condensed steam. But these processes were very expensive, and it was not till 1705, when Thomas Newcomen, a blacksmith of Dartmouth, England, applied a piston to a cylinder where [illegible] condensation of steam, that the elements of a practicable steam engine were connected together.

To Newcomen, therefore, must be given the credit of being the inventor of the steam engine, since he discovered the combination of mechanism that was afterwards developed by others. James Watt, Oliver Evans, Robert Fulton, Richard Trevithick, George Corliss and a host of other inventors were merely the discipies of the apostle Newcomen, who led the inventive world out of the wilderness of speculative uncertainty to the light of productive action.

There is a very interesting and beautiful illustration of the principle of Bramah's hydrostatic press in the contrivance [illegible] their honey. The cells, open at one end and closed at the other, are arranged horizontally over each other, and in that position are filled with the liquid treasure. Now, suppose a [illegible] tubes laid on their sides and piled upon one another in like manner were required to be then filled with water, it certainly would re[illegible] a plan [illegible] which the operation could be performed, but whatever mode were hit upon, it could not be more ingenious and effective than [illegible] gineers.

[illegible] movable piston [illegible] the sides, and when a bee arriv[illegible] honey which is containe[illegible] [illegible] trates the piston with her probo[illegible] and [illegible] een the [illegible] ton, and [illegible] with her feet [illegible] as the honey accumulates behind it, till [illegible] vessel and excluding the air [illegible] as one cell is thus charged [illegible] will be perceived that these pistons [illegible] propelled precisely as in the hydrosta[illegible] impr[illegible] sible (with any force to which it is there subjected), every additional particle forced in necessarily moves the piston forward to afford the required room. Without such a contrivance the cells could no more be filled, and kept so, than a bucket could be filled with water, while lying on one side. Were the organization of bees closely examined, it would doubtless be found that the relative diameters of their proboscis and of the cells, and the area of the (bellows) pumps in their bodies are such as are best adapted to the muscular energy which they employ in working the latter. Were it otherwise, a greater force might be required to inject the honey and drive forward the piston than they possess. In the case of a hydrostatic press, when the resistance is too great to be overcome by an injection pump of large diameter, one of smaller bore is employed.

Short Trains.

The question of the greater degree of safety on short or long trains is being discussed on some of the railroads in the Middle West, with a degree of vehemence that is at least a proof that there is a desire to get at the truth of the matter. Mr. Marcus A. Dow, of the New York Central Lines, who has done excellent work in aid of the "Safety First" movement, has repeatedly asserted that accident records conclusively show that the majority of injuries are caused by carelessness, and that no train limit law will prevent injury to an employee who does not take care. Mr. Dow calls particular attention to some of the advertising matter that has been sent out by supporters of this "Short-train" bill which is in course of discussion in Illinois. A postal card sent broadcast decries the fact that 594,-359 people were killed and injured on the American railroads in the three years from June 30, 1911, to June 30, 1914, and particular stress is placed on the fact that 31,-851 of these injuries resulted fatally. The fact that 16,463 of these persons killed, or more than 51 per cent., were trespassers, who voluntarily and needlessly risked their lives by going upon the railroad tracks, is intentionally suppressed. Nor is any explanation made that 12 per cent. of the killed were travelers on the highway, and that only 30 per cent of the killed were railroad employees, while only 3 per cent. of the killed were passengers.

Supporters of the bill maintain that railroad work is the most hazardous of all occupations and that a railroad is a veritable industrial slaughter house, whereas railroad casualties form only a small part of the total industrial accidents annually. There are nearly 40,000 persons killed annually in industrial occupations, and more than 2,000,000 injured, and these figures [illegible] cidents, such as those occurring in the city streets. In New York City alone in 1913, a total of 5,750 persons met violent death in the Borough of Manhattan.

To extend the investigation further and compare railroad accidents with other industries, the number of persons killed per 1,000 in some other industries are as follows: Metal mining, 4.20; coal mining, 3.50; navigation, 3.00; railroad employees, 2.40. It will thus be seen that in reality there is less hazard connected with employment on a railroad than in several other important industries in the country.

Coming back, however, to the proposed legislation in regard to the length of trains, we would not care to venture an opinion, in the absence of exact data as to the liability to accident on account of the length of a train. Statistics could be secured, and no doubt, as the discussion proceeds, reliable data will be forthcoming, and whatever tends toward the safeguarding of life and limb by all means let it be speedily adopted.

Steel Rails in Australia.

The Broken Hill Proprietary Company's Iron and Steel Works at Port Naratah, Newcastle, Australia, were opened last June amid much demonstrations of acclaim. The Governor-General, Sir Ronald Munro Fergusson, accompanied by the Governors of New South Wales and Tasmania, were present, and a large number of representatives of the Federal and State Parliaments. The works are the crowning achievement of a great undertaking, with ramifications in many States of the Commonwealth. All Australia is interested, the raw material being drawn from mines in many parts of the country, and the product will make the railways of Australia independent of foreign supplies. The machinery and appliances are of the best, and sufficient orders were on hand before beginning to keep the works going for at least one year. The manufacture of steel rails was begun on the opening day.

Successful Railroad.

The best paying railroad in the world, according to length, is the Sandersville road, running from that city to Tennille, Ga., a distance of three and one-half miles. In 1913 and 1914 a twenty per cent. dividend was declared, while in some years forty per cent. has been made on the capital stock. The road's rolling stock consists of two locomotives and two coaches. Freight cars are used on the per diem basis. It makes four round trips daily and hauls practically all the freight coming to Sanders-

Air Brake Department

Operation of Empty and Load Brake When in "Load" Position

Rate of Equalizing Reservoir Reduction

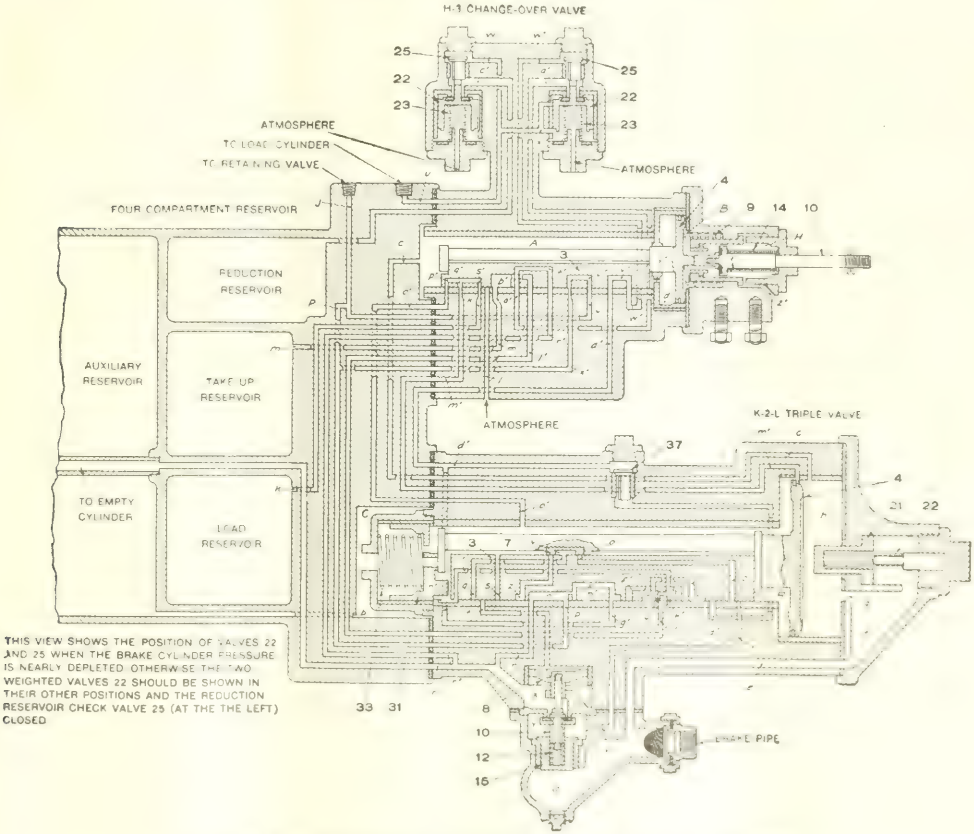
Last month we explained the features of the empty and load brake for freight cars when the brake is operating with the change-over valve in empty position and at the present time it is desired to comment upon the operation of the valves when the braking force is provided for a certain per cent of the load or total weight of the car. After the car is loaded, the operating lever is moved to load position manually and in so doing a vent valve at the back of the change [illegible] is unseated and the brake pipe pressure entering the change-over slide [illegible] ber, as explained in release [illegible] position last month, moves the change-over valve and piston to the right until the piston seals against the cylinder cap gasket when the slide valve [illegible]

connections for charging the load reservoir, by the way of the triple valve slide valve chamber through the change-over slide valve, and the take-up reservoir is charged from the triple slide valve chamber through different ports in the change-over slide valve so that in release position the auxiliary reservoir, load reservoir and the take-up reservoir are charged up to the pressure carried in the brake pipe while the brake cylinders [illegible] atmosphere.

[illegible] added volume so that the charging time in load position will be the same as when in empty position. This being from the triple [illegible]

designated as M^1, as in illustration.

[illegible] desired a brake pipe reduction has the same effect as outlined in empty position and whether the valve assumes quick service or full service position depends upon the rate of reduction, but in either event, [illegible] both slide valves and check valves 37 and



[illegible]

25 and again through the change-over slide valve to the empty brake cylinder, [illegible] whereupon the added braking [illegible]

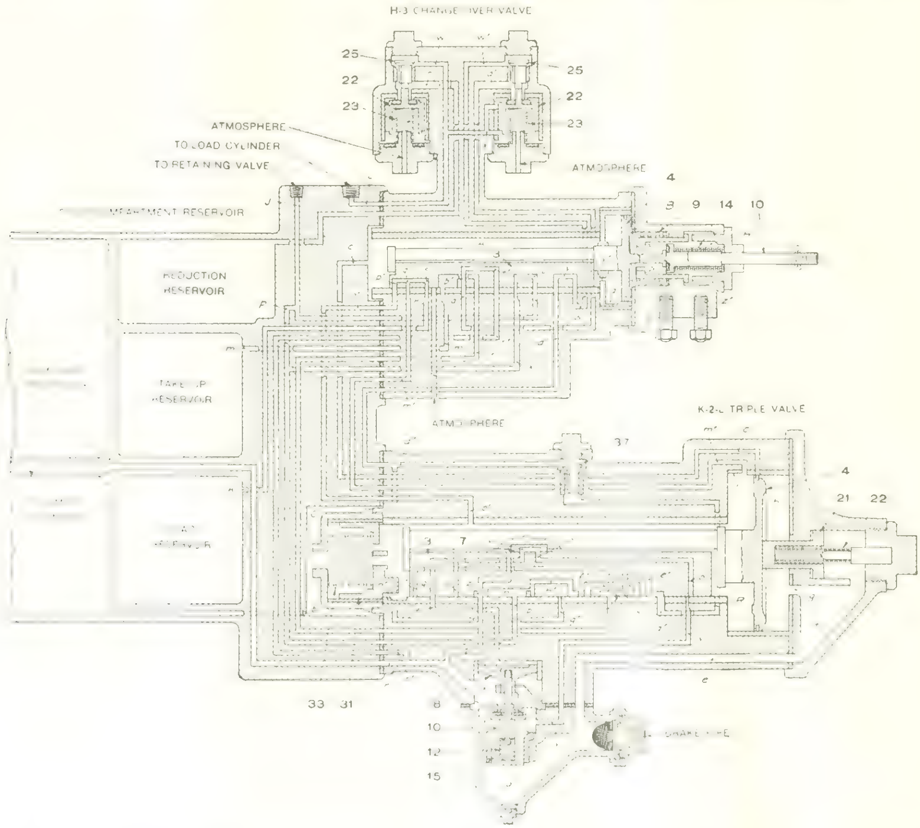
When the pressure in the empty cyl- [illegible]

… spring … wered and … which … reservoir … reservoir, auxiliary reservoir and empty brake … to the load brake cylinder and past valve … reservoir, the same movement cutting off the load cylinder from the atmosphere.

… the duty of the reduction reservoir is to momentarily or temporarily increase … reducing … the take-up reservoir after a heavy … reduction … brake pipe pressure … force for the load is secured at the start … brake cylinder pressure and continued at … piston area; consequently, in order to obtain a uniform increase of braking force … the doubling of the piston area.

Lap position of the triple valve means merely a cessation of brake pipe reduction … lower position after a heavy reduction … limits load brake cylinder pressure to … with the empty cylinder pressure … the retaining valve. After pressure … valve 22 has been reduced to about 5 lbs., the spring will force the valve to … upper position and permit the remainder of the load cylinder pressure to … through the drilled port in the cap nut; however, if the retaining valve handle is turned up this does not occur as valve 22 remains in its lower position.

In the emergency position, the triple valve operates as with any type of quick … valve, making a brake pipe opening …



… doubling of piston area will not produce … sudden an increase in braking ratio … reservoir pressure reaches 12 lbs., spring … the left will be overpowered and … valve 25 (left) will … seat, separating … reservoir and the load cylinder. The …

… prevent any further flow from the auxiliary reservoir to the empty brake cylinder … brake pipe pressure is increased after an application, the triple slide valve exhaust cavity opens the empty brake cylinder to the retaining valve and atmosphere as …

… seat of the … through the change-over valve to the load cylinder is the same as in service position … giving maximum brake cylinder pressure practically …

Under ordinary service conditions, the triple valve should be thoroughly cleaned and lubricated once a year. The proper interval is best determined for each particular …

trial. Where conditions are severe and the triple valve exposed to extremes of weather, dirt and so on, more frequent inspections will, no doubt, be found necessary. Where the valve is protected and not subjected to hard usage the interval [illegible]

In lubricating the triple valve, no lubricant should be used on the quick action parts.

After the bearing surfaces have been properly rubbed in by a free use of oil, [illegible]

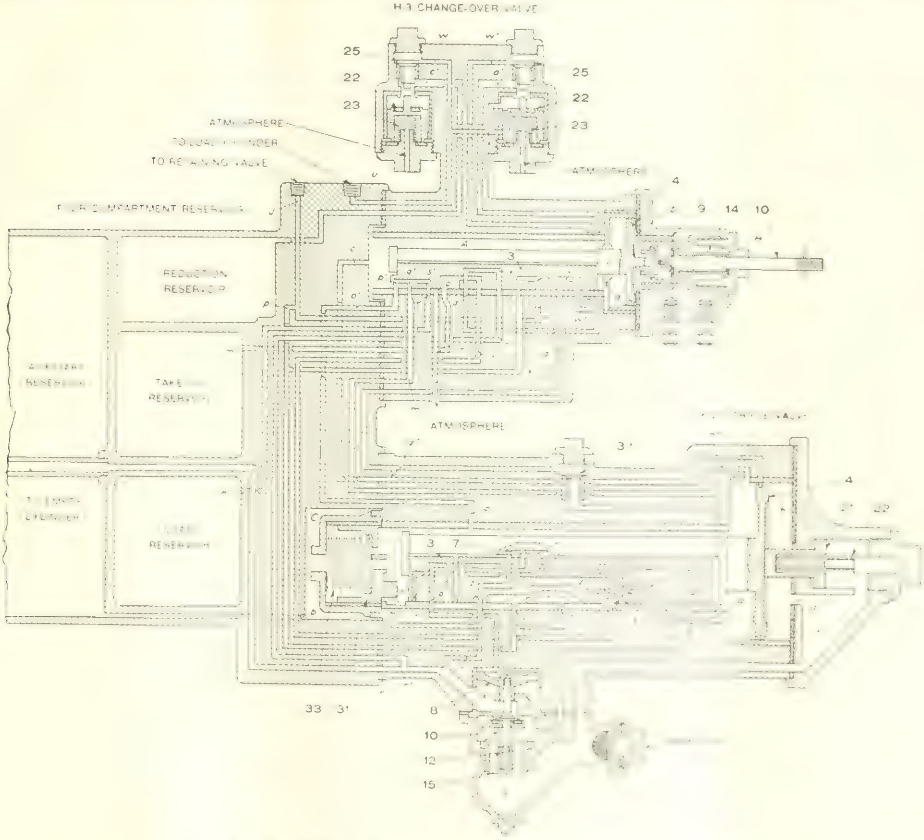
To apply the graphite, use a stick in the shape of a paddle about 8 inches long and having a small piece of chamois glued to one end. Dip the skin-covered end in dry graphite and rub on the surfaces specified. After rubbing, a light blow of the stick on the slide valve seat will leave the desired light coating of loose graphite. When the work is completed, the slide valve and its seat must be entirely free from oil or grease. Care should be taken when handling the parts after lubricating that the hands [illegible]

[illegible]

The change-over slide valve and seat and piston should be lubricated in the same manner as the corresponding parts of the triple valve.

Rate of Equalizing Reservoir Reduction.

The size of opening through the preliminary exhaust port bushing of the brake valve has been the subject of con- [illegible]



VOIR

cloth or some soft material. All oil, gum or grease should be thoroughly removed from the slide valve and its seat in the bush and the face of the grad[illegible]

The face of the graduating valve, both [illegible] the slide valve, the slide valve seat and the upper portion of the bushing where the slide valve spring [illegible] lubricated with a high grade of very [illegible] dry, pure graphite, rubbing it in so th[illegible] as possible will adhere and fill the pores of the brass and leave a very [illegible] thin coat of graphite.

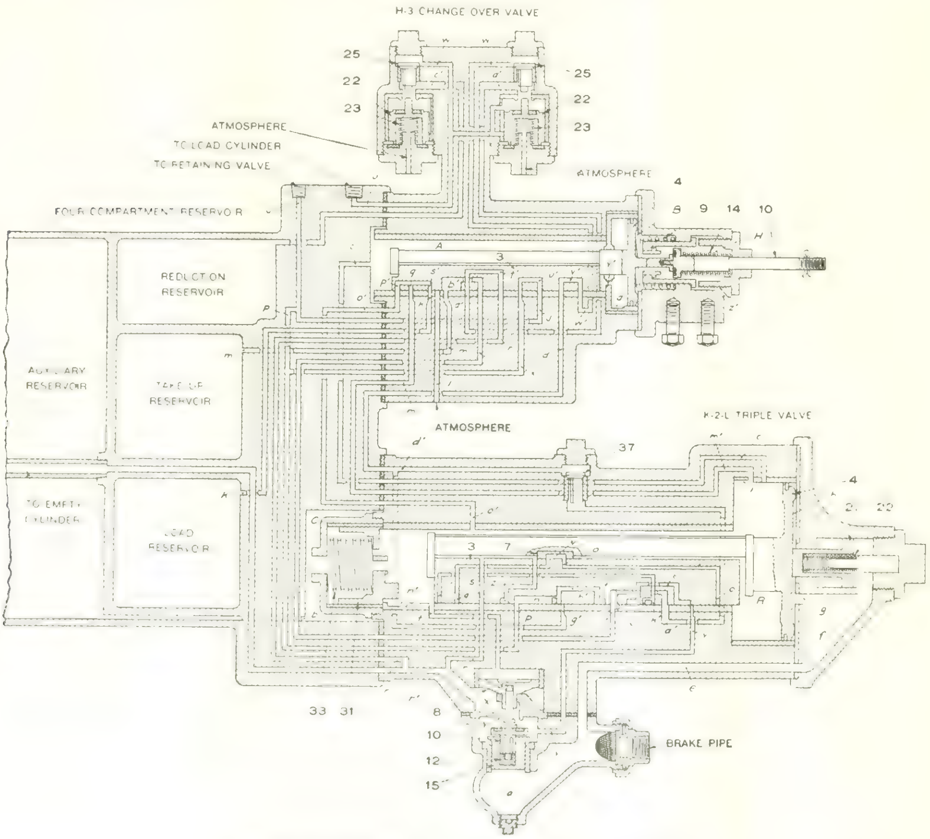
with the lubricated parts as the thin coating of graphite is easily removed.

The triple valve piston ring and the [illegible] sparingly lubricated by first pushing the piston to release position and applying a drop or two of oil to the circumference of the piston bushing, spreading it over the surface as uniformly as possible and then moving the piston back and forth several times [illegible] this oil on the wall of the cylinder. There should be no free oil left on the parts. Care should be taken not to permit any oil

[illegible] air brake club meetings and in [illegible] shops, since the Air Brake Company has found it necessary to change their standard in the H-6 brake valve. [illegible]

[illegible] arguments against the change or reduction in the size of opening, the [illegible] is to pay more attention to ac- [illegible] in its bushing and the consequent [illegible] of equalizing reservoir reduction.

To understand why this change was considered advisable it is necessary to appreciate the difference in past and present methods employed in fitting equalizing pistons and piston rings in brake [illegible] equaliz[illegible] in the [illegible] and tr[illegible]ing up for the renewal of piston rings the pistons were sometimes as much as 1/16 inch smaller than the inside diameter of the bushing and a very heavy ring, known [illegible] was [illegible] 7[illegible] seconds, which represented a fair average condition [illegible] However when the older method and the heavier friction ring were [illegible] and it became a practice to use a neatly fitted equalizing piston and a standard packing ring such as used in triple valves, the leakage from the brake pipe into the equalizing reservoir became a negligible quantity and shortly thereafter some cases of undesired quick action were traced to what appeared to be an unneces[illegible]



[illegible] ing a certain stability to the movement of [illegible] past the ring.

The inevitable friction ring, or packing [illegible] piston in its bushing the greater the leak[illegible] [illegible] opening through the preliminary ex[illegible]

[illegible]

Upon an investigation it was found that this reduction from 110 to 90 lbs. was taking place, in [illegible] instances, in considerably less than 5 seconds' time and it [illegible]nerally agreed that this should take [illegible] and in order that the brake valve may be [illegible] considered and thereafter the size of open[illegible]

A [illegible] 1/16-inch opening to the atmosphere will reduce the pressure in the [illegible] 14 [illegible] equalizing reservoir [illegible] the standard size since the introduction of the [illegible] brake [illegible] brake [illegible] pipe [illegible] 10 [illegible] lbs., in from $5\frac{1}{2}$ to 6 seconds' time, and if a considerably longer time is required it indicates leakage into the equalizing reservoir which adds to the volume of compressd air to be expanded, hence if the rate of reduction is too slow and it is [illegible] structed and of the correct size, the source [illegible] examination of the rotary valve and seat and body gaskets will usually disclose any defect and if none is found, it is safe to assume that the leakage is past the [illegible] the essentials here are a neatly fitted piston, a true bushing and a well fitted ring both as to fit in piston groove and to bearing surface in bushing.

There may be reasons why an accurate [illegible]

[illegible] leakage is kept within a reasonable limit, [illegible] ample size for the required rate of reduction. From 70 to 50 lbs., the reduction will occur in from 9 to 11 seconds, which is rapid enough for freight service especially under modern operating conditions, which is to say that 9 to 11 seconds from 70 to 50 lbs. pressure is equivalent to 5½ to 7 seconds from 110 to 90 lbs.

If, however, a 5/64 opening is used in the preliminary exhaust port bushing, a rack test will show the equalizing reservoir reduction from 110 to 90 lbs. to be taking place in 4¼ to 4½ seconds' time, under certain conditions, which is too rapid to provide the necessary margin between service and emergency rates of brake valve reduction, not to say that this in itself will be the cause of undesired quick-action, but it is acknowledged to be one of the contributing causes of the disorder and during such occurrences it is always important to also observe the opening through which brake pipe pressure is exhausted as this is a fixed opening the size of which will not be indicated during a test of locomotive brakes, and can only be ascertained by measurement. This opening is 7/32 of an inch when the discharge is straight-away, ¼-inch when an exhaust fitting is used, and 9/32-inch when an angle fitting, or an additional elbow is added.

When Prostrated by Electricity.

Electrically operated machines are becoming so common in railway repair shops that personal injuries from electric shocks are becoming quite numerous. The means for resuscitation in electric shock accident are the same as those for surviving death from drowning. Accidental shocks seldom result in absolute death unless the sufferer is left too long unaided, or efforts at resuscitation are stopped prematurely. It is well also to remember that the victim seldom receives the full force of the current in the circuit, but usually only a short current, which may represent a very insignificant part of the whole. Well directed efforts, persevered in faithfully, will in the great majority of cases restore those who have been prostrated by an electric current shock. Hundreds of people are in their graves, sent there by electric shocks, who would be enjoying robust life had only persistent care been used for their recovery.

The Liberty Bell.

The Pennsylvania Railroad Company has had a specially constructed steel car to convey the Liberty Bell from Philadelphia to San Francisco. Every precaution that engineering skill could devise has been taken for the safety of the Bell. To avoid the shocks and jolts of travel and to eliminate vibration as completely as possible, the big steel "gondola" car upon which the Bell rests has been equipped with specially designed steel springs of the greatest flexibility and strength, and scientifically adjusted to the exact load they are to bear.

These springs were designed by the company's mechanical engineer and were constructed at the company's Altoona, Pa., shops. The car itself has a capacity of 100,000 pounds, which is far in excess of the weight it carries.

The Bell is suspended in the center of its car from a huge frame of seasoned ash, finished in Mission style and weighing about one ton. Surmounting the frame is the inscription, "1776—Proclaim Liberty." This frame, or hanger, is bolted securely to the floor of the car, which is covered with linoleum. The car itself has been painted a bright red. A brass railing has been built around its edge for the convenience and protection of its guard of four Philadelphia traffic policemen, of Herculean mold.

Accidents on Steam Railways.

The number of persons killed in train accidents during the months of October, November and December, 1914, as shown in reports made by steam railway companies to the Interstate Commerce Commission under the accident reports law of May 6, 1910, was 78 [illegible] of persons injured, 2,238.

The total number of persons reported killed in all classes of accidents was 2,162, and the number of persons injured 41,030. This statement includes 2,002 persons killed and 14,352 persons injured as the result of accidents sustained by employees while at work, by passengers getting on or off cars, by persons at highway crossings, by persons doing business at stations, etc., as well as by trespassers and others; and also 82 persons killed and 24,440 persons injured in casualties reported as "industrial accidents."

Blackmail.

The people of the world first became familiar with the term "blackmail" through descriptions of its operation in Scott's "Waverly." This is no doubt true and it is also true that Great Britain was the land of the original "blackmail," the mail, rent or tribute paid on the Anglo-Scottish and Highland borders by farmers and others to freebooters in return for immunity from their visitations. In Ireland a similar swindle was known as "black rent," the word mail meaning rent, as common; either from Anglo-Saxon, "mael" a portion of the old French "maille," a half penny, is quite a different word from the postal "mail" which was originally "mal," a [illegible] "black-mail" had an innocent significance, meaning rent paid in labor or produce as opposed to "white rent," paid in silver or white money.

The Shantung Railway.

It was considered a necessary part of the attempted defense of Tsingtau by the German forces to render the Shantung Railway incapable of military use by the oncoming Japanese forces. In this they were materially assisted by extensive floods occurring at the end of August. In the latter part of October, however, the American Consul made the trip from Kiochow to Tsinan, although the journey was very slow because of several dynamited bridges and portions of track damaged by floods. Local newspaper reports state that about $300,000 have been appropriated for the repair of the railway and that the repairs will be finished this summer. This news is not official, but it is certain that the railway repair shops at Syfang are being put into order. Immediately after the capture of the railway the Japanese military authorities placed it under the control of an organization of soldiers and conducted it as a military line, although passengers and freight were accepted for transportation. On March 25, however, a civilian management was organized, and the latter assumed charge of the railway on or about April 1, 1915.

Outside Passenger on the "Flying Scotsman."

At Crewe recently, Private William Smith, Royal Dublin Fusiliers, was charged with absenting himself from his regiment. He was found at Crewe clinging to the buffers of a carriage on the "Flying Scotsman," which runs from Euston to Carlisle with only one stop. He was in a thoroughly exhausted condition and was as black as a sweep. For three hours he had clung to a frail rail. [illegible]

A Fool Who Knew Money.

In a Scottish village lived Jamie Fleeman, who was known as the "innocent," or fool of the neighborhood. People used to offer him a sixpence, a silver coin and a penny and the fool would always choose the big coin of small value. One day a stranger asked: "Do you not know the difference in value that you always take the penny?" "Aye fr'in, I ken the difference," replied the fool, "but if I took the sixpence they would never try me [illegible]

It is reported that the Franklin, Pa., plants of the Chicago Pneumatic Tool Company will soon be put in operation day and night on an order for shells estimated up to 300,000 received from the Bethlehem Steel Corporation.

The "Sickles" Extensible Trap Door

An Important Improvement on Passenger Cars—Introduced by the Pennsylvania Railroad Company

[illegible] similar platforms at Wilkinsburg and Johnstown, on its Pittsburgh Division. The adoption of the high platform by this company is in line with its policy of obtaining the best of railroad features. The [illegible] parent to all railroad men, but a difficulty has arisen in connection with their adoption where the platform is built on a [illegible] the end of car and platform. The physical con- [illegible] it impossible to build tangent platforms.

This company has equipped for trial a steel vestibule car with the "Sickles" Extensible Trap Door, as shown in the ac- [illegible] designed to bridge the gap between the car and station platform.

When the trap is down the opening of the vestibule door causes the sliding portion to extend, the closing of the vestibule door returning same. This arrangement is ideal in view of the fact that the extension of the trap is required simultaneously with the opening of the door, and, as the vestibule door is required to be closed on leaving station, the trap is necessarily returned at the same time. [illegible]

[illegible] open vestibule door is utilized to extend trap.

[illegible]

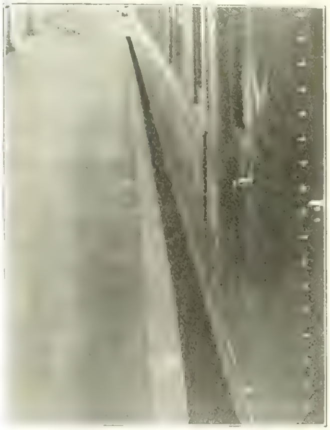
[illegible]

[illegible] can be thrown out of gear by means of a small handle set flush inside of the vestibule at [illegible] height. It is not necessary with this trap to provide extra trainmen to attend to its operation [illegible] position, which is done by brakeman before train reaches station, the opening of the vestibule door, whether accomplished [illegible] to be thrown by movement of extension; furthermore, it is impossible for passenger [illegible] being opened.

The trap is, in outward appearance, like the ordinary trap, and consists of a rubber covered top plate (A) and the extensible portion (B) which is built in the familiar [illegible] use of steps. The hinge rod (C) is hollow and accommodates the flat springs [illegible] (D), to obtain the proper tension to raise [illegible] supported by means of bracket (E), which slides on hinge rod, and by means of lug [illegible]

[illegible] and at the [illegible] angle iron ledge, the extended portion cannot deflect when passenger steps on [illegible] H) are used respectively to hold trap down when door is closed and to hold same up against vestibule door when trap is raised for use of steps.

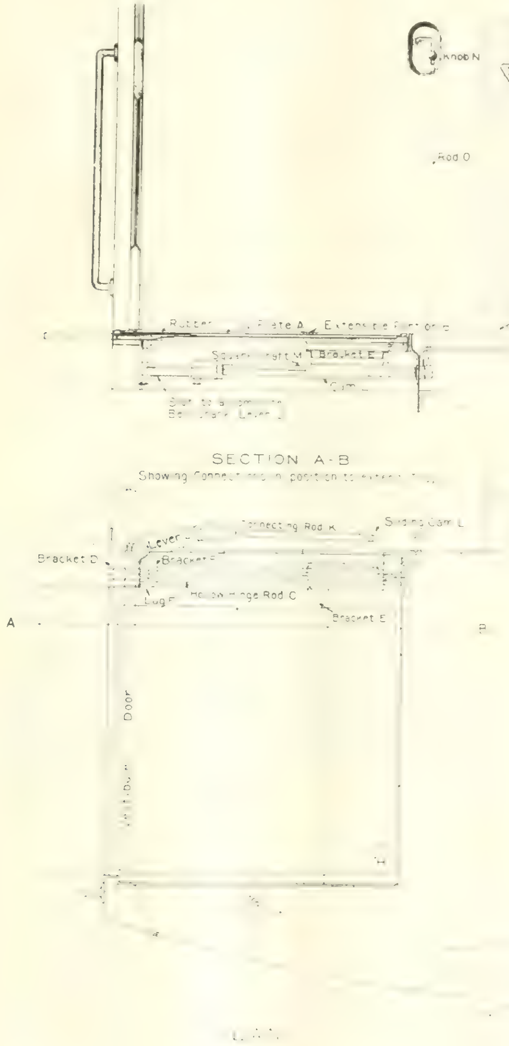
The operating device consists of the bell crank lever (J), attached to vestibule door, the connecting rod (K) and cam [illegible] When square shaft (M) is tilted to place sliding cam (L) in "off" position, the [illegible] causes cam to slide on shaft without any effect on extensible portion of trap. The square shaft (M) is tilted by means of the small knob (N) on end of rod (O), which is attached to lever on end of square shaft. When square shaft is thus tilted, the sliding cam (L) comes up in [illegible] that when door is opened the sliding part of trap is extended. The sliding cam (L) is designed so that whether in "on" or "off" position, the front finger of same is always in position to hold in extensible part of trap, so that it is absolutely impossible for [illegible] closed. The trap is arranged so that it is impossible to raise same when extended [illegible]



[illegible]

[illegible] trap is designed with a uniform extension to take care of the gap at platforms built on a [illegible]

overlap the platform an inch or two, the station platform, of course, [illegible] a small step below floor [illegible] to the varying heights of the car floors above the top of rail, due to weak springs, etc., it has been found impracticable to maintain the car floor on [illegible] the station platform, but the [illegible] meets the situation.



[illegible]

The design is protect[illegible] patents of January 6 and Ma[illegible] by Ellwood H. Sickles, 2[illegible] Woodside avenue, Narberth, Pennsylvania.

Aisle No Place for Grips.

We have always [illegible] trains with grips and other baggage a nuisance worthy of being suppressed. This miserable practice proved expensive [illegible] it paid [illegible] to passengers who tripped over other passengers' grips. That is one of the reasons why [illegible] men [illegible] permit luggage to remain in the aisles of passenger coaches.

Retiring Wooden Coaches.

Wooden passenger coaches are rapidly becoming relics of the past as a result of the safety programme of the railroads. The report of the railway committee on operation of lines in the United States and Canada shows that of the 956 coaches under construction on January 1 only three were of wood and only two were to be used in the passenger and carrying business. The report indicates 4,614 wooden cars have been retired in the last three years.

Clerks Talked Strike.

The clerical department of railroads have very little trouble with managements as a rule, but a case comes up occasionally, when strike threats are indulged in with a view of bringing the management to terms. A case of this character has just been settled on the New York, New Haven and Hartford.

The freight clerks of that road declared they were suffering under sixteen grievances of an intolerable character. When a strike seemed imminent, Mr. G. W. W. Hanger, a Federal mediator from Washington stepped in and effected a settlement. The most important question which involved the right of appeal, was settled by the substitution of a rule providing that clerks may appeal grievances, except in competency cases, to the general superintendent, who shall appoint a committee, of which he may be a member, to hold a hearing.

Electric Equipment for the Ogden, Logan & Idaho Railway.

[illegible] Logan & [illegible] pany, Ogden, Utah, have ordered from the Westinghouse Electric and Manufacturing Company two stationary substations, each consisting of a 500-kw. motor-generator set; 2,300 volts, 3-phase, 60-cycle, 900 r. p. m. synchronous motor; 1,500-volt direct current generator; 10-kw. direct connected exciter; three 235-kva. single-phase, 60-cycle O. I. S. C. transformers, 45,000 2,300-volts and a switchboard to control same. Also a portable substation with similar equipment using [illegible] paratus is in addition to the original order given the Westinghouse Company a year [illegible]

The Pittsburgh Street Car Company, Pittsburgh, Pa., has been incorporated at [illegible] will manufacture and deal in steel [illegible] cars. The incorporators are: [illegible] Norman P. Coffin, Mr. Herbert E. [illegible] Wilmington, Del., and Mr. Clem[illegible] Enger, Elkton, Md.

Electrical Department

Remarkable Performance of Pennsylvania Railroad Locomotives

[illegible] performance during the period in a very striking manner. They were designed to start and accelerate a 550-ton train, in addition to the locomotive, on a 1.93 per [illegible] started on this grade, and trains of four- [illegible] 1000 tons are handled without difficulty. Each locomotive in service passes over an in- [illegible] ning inspection of machinery is made, similar to that given steam locomotives over the pit, and slight repairs made where necessary. The average time re- [illegible] mately 10 minutes. After 3,000 miles' run, the locomotives are taken into the shop for a general or periodic inspection, when [illegible] over, tested, cleaned and necessary ad- [illegible] trical and mechanical parts. The shopping of these locomotives for general repairs is governed by tire wear, and a number of locomotives have run from 90,000 to 112,000 miles before it was necessary to turn the tires or do any general repair [illegible]

The general overhauling and repairing of these locomotives is done in one of the [illegible] On November 28, 1914, these 33 locomotives had completed four years' service, and during that period the mileage made and detention record is as follows:

[illegible]	[illegible]
Total engine failures..........	45
Total minutes detention to trains.	271
Locomotive miles per detention...	88,328
Locomotive-miles per minute detention	[illegible]

During this period, 463,558 train movements were made, or an average of 1,300 movements per detention, due to engine failures.

At Manhattan Transfer, where the change is made from steam to electric locomotive on trains to and from the Pennsylvania station, the time allowed per schedule for making change, including necessary testing of air brakes, is four minutes, although the entire operation [illegible] be performed in three minutes, and [illegible]

[illegible] similar in general character to the standard American type steam locomotive, and the relation of the various working parts on the two semi-units is similar in location to [illegible]

Each [illegible]

[illegible] PENNSYLVANIA RAILROAD [illegible] ELECTRICAL LOCOMOTIVES

[illegible] ing wheels through a system of parallel rods and cranks with an intermediate [illegible] Westinghouse [illegible] electric headlight, pneumatically operated whistle, sand apparatus and other items [illegible] equipment is so arranged that in the event [illegible] entire locomotive can be operated from the other cab with the remaining motor. The unit switch control permits two or more locomotives to be coupled and all to be operated from either end of any one cab. The semi-units are interchangeable, and if any two semi-units are separated, they can be combined with any two other semi-units, as may be required in making repairs, or for other reasons. The controllers are fitted with four running notches, giving great flexibility of speed [illegible] nomical use of power during acceleration.

Each motor has a continuous rating of [illegible] and a [illegible] rating of [illegible] horsepower, or a total of 4,000 horsepower per locomotive. The motors are of the direct-current, field-controlled commutating-pole series type. The weight of each motor complete, including cranks, [illegible] pounds. The motors are supplied with direct current at 650 volts from the third rail, through contact shoes, located on either side of each truck. The motors, control and the complete electric equipment was furnished by the Westinghouse Electric and Manufacturing Company [illegible] built by the Pennsylvania Railroad in its own shops at Altoona.

The rated tractive power of each locomotive is 66,000 pounds, but in actual service 79,200 pounds has been registered on several occasions.

WEIGHTS AND DIMENSIONS

Weight of locomotive complete..	156.5 tons
Weight per driving axle.......	49,750 lbs.
Total weight on drivers.......	199,000 lbs.
Weight on each truck	57,000 lbs.
Total length overall...........	64 ft. 11 in.
Rigid wheel base of each semi-unit	7 ft. 2 in.
Total wheel base of each semi-unit	[illegible]
Total wheel base of each locomotive	55 ft. 11 in.
Total height of locomotive....	14 ft. 8½ in.
Total height of cab........	13 ft. 1 1/16 in.
Total width of cab	10 ft. [illegible] in.
Diameter of drivers................	72 in.
Diameter of truck wheels...........	36 in.

The Goff Electro-Pneumatic Brake

Its Early Adoption in Passenger Traffic Looked For

For simplicity of construction in apparatus providing for the electric control of pneumatic brakes, we commend the idea of Mr. Frank Goff, of Camden, N. J., a locomotive engineer of the Pennsylvania R. R.

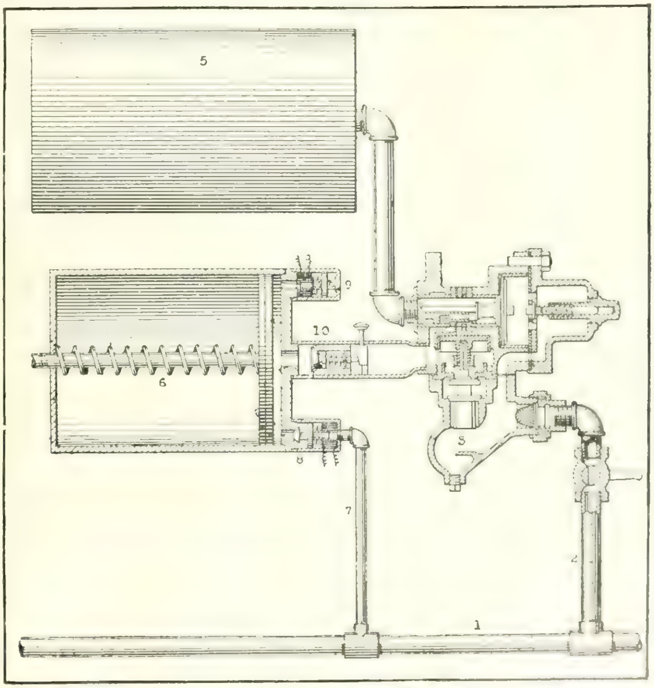
The accompanying illustration shows the electric attachment patented by the inventor which consists of two magnets and valves and one check valve and one additional connection between the brake cylinder and the brake pipe. Those who have read our articles on electro-pneumatic brakes will understand that with such installations a magnet is used to operate an air valve which is termed a magnet valve. Thus by alternately energizing and de-energizing the magnet through electric current the air valve is opened and closed as desired.

During the recent Air Brake Convention in Chicago, several well known air brake men expressed the opinion that the electro-pneumatic brake would be in general use in freight service before the majority of passenger trains were so equipped and we could agree with this if a sincere effort was being put forth in a systematic manner to bring the present freight brake to somewhere near its maximum state of efficiency.

While efforts to obtain a maximum efficiency in freight car brakes are made in some more or less isolated instances, there is no generally united movement calculated to bring the present freight brake to a state that would justify the use of electrical current, assuming that electricity cannot become a necessity until the pneumatic features are fully developed and utilized. However, from a certain point of view, the use of electric current is already necessary to insure a smooth handling and consistent operation of brakes on 100 to 150-car trains and when this is recognized as a necessity, we would suggest an investigation of the Goff System of electric control.

From the cut it will be observed that there are two electric valves connected with the brake cylinder, one an application valve the other a release valve. The system is charged through the triple valve in the usual manner and each car is equipped with electrical conductors to form a continuous line throughout the train. The contact made on the locomotive may be at the brake valve or with a separate push button but in either event it is only necessary to close the application circuit and thus energize the application magnets at each brake cylinder to produce an electric application of the brakes. This will admit brake pipe pressure to the brake cylinders simultaneously throughout the train and result in the movement of triple valves through which auxiliary reservoir pressure is also admitted to the brake cylinders. The pressure developed in the brake cylinder is determined by the time the application circuit remains closed. As soon as the circuit is broken, the magnets are de-energized and the valves returned to the normal position by the spring located between the magnet and the valve. Any pressure may be delivered to the brake cylinder, as with the brake valve in release position, main reservior pressure may flow direct to the brake cylinders. As magnet valves and permit the brake cylinder pressure to escape to the atmosphere. All pressure may be released or the release may be graduated with any desired reduction at exactly the same instant, regardless of length of train.

As an example of the flexibility of the brake, during an ordinary stop the brake may have been applied with a somewhat greater degree of force than desired when it is only necessary to close the release circuit to exhaust any desired amount from the cylinders and if a trifle too much



1. Brake Pipe.
2. Branch to Triple Valve.
3. Triple Valve.
4. Branch to Auxiliary Reservoir.
5. Auxiliary Reservoir.
6. Brake Cylinder.
7. Branch to [illegible]
8. Electric Application Valve.
9. Electric Release Valve.
10. Automatic Retaining Valve.

a preventative for undesired quick action, the inventor points out that the brake cylinder piston is moved and the brake set before the triple valve and auxiliary action can take place thus automatically cutting out quick action when it is not desired. If desired each auxiliary reservoir may be piped direct to the application valve chamber whereby brake pipe and auxiliary pressure may be admitted to the brake cylinder without operating the triple valve. To release the brakes, the release circuit is closed, energizing the release magnets, which in turn unseat the release

is exhausted it is but necessary to close the application circuit in order to replenish the cylinders. With the automatic retaining valve 10, all pressure is retained in each brake cylinder. Thus while all brakes are set, all triple valves in release position and all auxiliary reservoirs are charged, and ready for any emergency, the brake [illegible] We cannot imagine anything simpler in the electric control of air brakes, and any further information concerning this de- [illegible]

Items of Personal Interest

M[illegible] has been appointed [illegible] of [illegible] the Santa Fe, with office at Needles, Cal.

Mr. W. H. Archer has been appointed [illegible] foreman of the Grand Trunk, with office at Palmerston, Ont.

Mr. J. W. [illegible] has been appointed master mechanic of the Toronto division of the Canadian Northern at Parry Sound, Ont.

Mr. [illegible] has been appointed [illegible] roundhouse foreman of the Cincinnati, Hamilton & Dayton, with office at Indianapolis, Ind.

Mr. A. Sturrock has been appointed master mechanic of the British Columbia division of the Canadian Pacific, with office at Vancouver, B. C.

Mr. Frank W. Wilmore has been appointed assistant road foreman of engines of the Pennsylvania Lines West of Pittsburgh, with office at Fort Wayne, Ind.

Mr. A. E. Hutchinson has been appointed general purchasing agent of the [illegible] Short Line, with offices at Salt Lake City, Utah, succeeding Mr. G. H. Robinson.

Mr. H. G. Ried has been appointed master mechanic of the Saskatchewan division of the Canadian Pacific, with office at Moose Jaw, Sask., succeeding Mr. M. J. Scott, transferred.

Mr. R. W. Spencer Robertson has been appointed secretary of the American Locomotive Company by the Board of Directors, [illegible] caused by the resignation of Mr. C. B. Denny.

Mr. S. K. Moorcroft has been appointed division storekeeper of the Canadian Northern at Saskatoon, Sask., succeeding Mr. A. E. Doun, resigned, to join the Dominion forces in Europe.

Mr. W. M. Bosworth, formerly mechanical engineer of the Louisville & Nashville, at Louisville, Ky., has been appointed mechanical engineer of the Norfolk Southern, with office at Berkeley, Va.

Mr. Roy W. Bond, formerly superintendent of shops of the Boston & Maine, at Concord, N. H., has been appointed general mechanical shop inspector on the same road, with office at Boston, [illegible]

Mr. A. R. Reuter, formerly general [illegible] has been appointed general foreman on the same road with office at Chicago, Ill., and Mr. W. T. Abbington becomes general foreman at Valley Junction.

Mr. H. E. Dyke, formerly general foreman of the Oakdale shops of the Chicago, New Orleans & Texas Pacific, [illegible] on the same road with office at Ludlow, Ky., and Mr. H. R. Tomda has been appointed general foreman at Oakdale, Tenn., succeeding Mr. Dyke.

Mr. E. B. De Vilbis, formerly electrical engineer of the Pennsylvania Lines West, at Fort Wayne, Ind., has been appointed assistant engineer of motive power on the same road, with office at Toledo, Ohio, and Mr. W. E. Stockbridge, formerly motive inspector at Fort Wayne, Ind., has been appointed electrical engineer.

Mr. P. Alquist, formerly superintendent of the car department of the Missouri, Kansas & Texas, has been appointed general superintendent of the car department of the same road, with office at Dennison, Tex., and Mr. William Walker, formerly general foreman of the Sedalia shops, succeeds Mr. Alquist at Sedalia, Mo.

The resignation of Mr. F. N. Hibbits, superintendent of motive power of the Lehigh Valley Railroad, who leaves to

[illegible]

join the Baldwin Works, has been accepted with regret by the company. All reports and communications to the office of the superintendent of motive power will, until further notice, be addressed to Mr. [illegible] assistant superintendent of motive power, South Bethlehem, Pa.

Mr. T. D. French has been appointed general foreman of the Rock Island with office at Belleville, Kan., and Mr. E. J. [illegible] succeeds Mr. French as foreman of equipment, at Herington, Kan., and Mr. C. W. Reid has been appointed road foreman of equipment, with office at Fairbury, Neb. Mr. G. I. Evans has been appointed district master mechanic of the Ontario division of the Canadian Pacific, with office at Toronto, [illegible]

[illegible] Smith [illegible] has been elected president of the International Railway General Foremen's Association, is shop superintendent of the Illinois Central Burnside shops, at Chicago, Ill., and has been prominently identified with General Foremen's Association. He is a fine type of the Western railroad man, and is very warmly appreciated by the officials of the Illinois Central as well as by the employees at the extensive shops.

Prof. Charles M. Spofford, M. A. M. Soc., C. E., of Fay, Spofford & Thorndike, consulting engineers, Boston, and head of the Department of Civil and Sanitary Engineering, Mass., Institute of Technology, has been appointed by Governor Walsh of Massachusetts, as one of the commissioners "to investigate the subject of terminal facilities and the improvement of facilities for the transportation of freight in the Metropolitan district." This commission is authorized to investigate the entire question of the development and improvement of facilities for the transportation of freight in and from and with relation to the city of Boston; to determine the proportion of cost which should be borne by the commonwealth, by the city of Boston, and by public service corporations, respectively.

Mr. Riley H. Phillips, engineer on the New York, New Haven and Hartford railroad, has just celebrated the anniversary of his fiftieth year of service with the company. Mr. Phillips is a typical New Englander. In his sixteenth year he enlisted with his father in the Fifteenth Connecticut Volunteers, and served all through the Civil War. In July, 1865, he started firing on the railroad. In 1868 he was promoted to engineer. Since that time he has managed every type of engine in the company's service. At present he is handling the Banker's Express from New Haven to the Grand Central terminal. Mr. Phillips has had some stirring experiences, among which was somersaulting down a ninety-five foot embankment on the locomotive of the Owl train, when a depot platform had been thrown across the track in a hurricane. The fireman was killed, but Mr. Phillips escaped with slight injuries. He is still in the front rank of engineers, bright and athletic as ever.

Mr. Edwin M. Herr, president of the Westinghouse Electric and Manufacturing Company, received the honorary degree of Master of Arts from Yale University last month. Mr. Herr has had a notable career as a railroad man. After graduating from the Sheffield

Scientific School of Yale in 1884, he became a special apprentice on the Chicago, Milwaukee & St. Paul Railway at the motive power department, and later was engaged as mechanical draftsman and test engineer, and superintendent of telegraphs, and latterly as division superintendent on the Burlington. In 1890 he was appointed master mechanic on the Chicago, Milwaukee & St. Paul, and in 1892 he was called to the superintendency of the Grant Locomotive Works at Chicago. In 1895 he was in Russia establishing locomotive works there. Then general manager of the Gibbs Electric Company of Milwaukee, and latterly superintendent of motive power of the Chicago & Northwestern. Thence to a similar position on the Northern Pacific. In 1899 he entered the service of the Westinghouse Companies, and

EDWIN M. HERR

after various promotions was elected president in 1911.

Mr. A. H. Mahan, locomotive foreman of the Grand Trunk Pacific at Prince George, B. C., has been appointed general locomotive foreman in charge of territory from Prince George to Edmonton, Alta., including intervening branch lines; Mr. J. F. Moffatt, road foreman at Wainwright, Alta., has been appointed general locomotive foreman in charge of the territory from Transcona, Man., to Fort William, Ont.; Mr. H. R. Simpson, road foreman at Jasper, Alta., has been appointed general locomotive foreman in charge of the territory from Watrous, Sask., to Winnipeg, Man., including intervening branch lines; Mr. W. G. McConachie, road foreman at Edmonton, Alta., has been appointed general locomotive foreman in charge of the territory from Edmonton to Watrous, including intervening branch lines, and Mr. A. Watt, general foreman at Prince Rupert, B. C., has been appointed general locomotive foreman in charge of the territory from Prince Rupert to Prince George. Mr. D. W. Hay has been appointed locomotive foreman, with office at Prince George, B. C., succeeding Mr. A. H. Mahan, and Mr. J. A. Miller has been appointed locomotive foreman at Endako, succeeding Mr. G. H. Laycock, transferred to Jasper, Alta.

OBITUARY

MATTHEW H. SHAY

Matthew H. Shay, whose name is known principally through the largest locomotive in the world belonging to the Erie Railroad being named after him, died on July 1 in his home at Cleveland, O., in the 74th year of his age. Mr. Shay had run locomotives on the Erie Railroad for more than fifty years, and was a remarkably fortunate engineer, having met with very few train accidents. He was a leading member of the Brotherhood of Locomotive Engineers, and for twelve years was secretary-treasurer, but declined election at the last convention owing to failing health.

WILLIAM MCKENZIE

William McKenzie, for the last thirteen years head of the floating equipment of the Southern Railroad, passed away in his home in Berkeley, Cal., in June last. Mr. McKenzie was born in New York City in 1836 and began railway work as a fireman when he was sixteen years old. After a few years' work in the East as a fireman he went to the Chicago, Burlington & Quincy as an engineer. He left that system early in the sixties to go gold mining, but like many others found that it is not all gold that glitters, and after a few years' experience of mining [illegible] at work on the Southern Pacific, first as engineer, then as master mechanic. In 1902 he was advanced to the position of superintendent of floating equipment, and kept on in that office till death closed his career. He was a very able mechanic, a pleasant gentleman and a popular official.

RICHARD S. BROWN

The death is announced of Mr. Richard S. Brown, a popular salesman for railway apparatus, and for twenty-five years connected with the Westinghouse Electric & Manufacturing Company, latterly in the Boston office, to which he gave loyal and energetic support until advancing years called a halt. Mr. Brown was in his seventy-sixth year, and was for many [illegible] officer at banquets or association meetings. Of a genial and gentlemanly disposition [illegible] ready and fluent speaker, with an inexhaustible fund of anecdotes, he enlivened every meeting that he attended, and like Yorick, "set the table in a roar." He was among the oldest and most noted electrical men in the country. Among his earlier connections was that of the Daft Company, that ran the first electric car on one of the piers at Coney Island, N. Y., in the early eighties.

MARTIN H. LEE

One of the best known engineers on the Pennsylvania, Mr. Martin H. Lee, died on July 11, at his home in Philadelphia. Mr. Lee was in his fifty-sixth year and had been thirty-six years in the service of the Pennsylvania. In passenger service Mr. Lee made several noteworthy records. On March 24, 1902, he ran the late President Cas-

MARTIN H. LEE

satt's train from Philadelphia to Jersey City, 90 miles in 77 minutes, including a 5-minute stop occasioned by a crossing freight train. This run was made on engine No. 804. Mr. Lee inaugurated the New York Chicago 18-hour train. On the first trip on the New York division Mr. Lee made up 20 [illegible] was one of the engineers running the Congressional limited from Jersey City to Washington. He made his last trip on that run on May 13, with engine [illegible] compelled him to retire. Our photographic reproduction shows him preparing for his last trip. Mr. Lee was highly respected by all who had the [illegible] of his acquaintanace. He was [illegible] many years prominently identified [illegible] Engineers, and occasionally contributed to our columns, and his death is [illegible]

Eleventh Annual Convention of the International Railway General Foremen's Association

The Eleventh Annual Convention of the International Railway General Foremen's Association was held in the [illegible] Hotel [illegible] on the four days, July 14 to 17. President W. W. Scott presided. [illegible] opening address, President Scott said:

The history of the International Railway General Foremen's Association, covering the ten years of our existence, shows a development along the lines of efficiency and economy in locomotive repairs that reflects considerable credit to the membership of this organization.

The increased size of locomotives resulting from attempts to meet the demands for heavy power, has in some respects put to a test the capacity of general, shop and roundhouse foremen, and in order to meet the increased demand on their resources, foremen are becoming affiliated with the various mechanical organizations with a view of meeting the advanced conditions in the most intelligent manner possible.

The papers presented to this organization for discussion in the past have been of exceptional high order and merit, and the subjects selected by the various committees for discussion at this convention will be up to our usual standard, and in your interest to keep abreast or ahead of the rapid progress in railroading you will bend every effort to give the subjects the attention they deserve.

In my recommendations for the future welfare of this organization, I wish to include a plan that may help bring about the consolidation of mechanical associations. The subject was treated by President F. F. Gaines in his opening address to the Convention of the American Railway Master Mechanics' Association June last, when he said in part:

"I think that the time has now come when we should have under whatever title we may choose, one organization only, divided into such sections as may be found advisable. Most of the members of the various associations come under the jurisdiction of the mechanical department of a railroad. It would seem not only advisable but very desirable that some such new organization be formed to take over to a certain extent control of all the others. They need not necessarily meet at the same time; in fact, I think it would be better to spread the meetings out as at present, but the executive committee of the Supreme Association should pass upon the work of the minor associations."

I am very much in favor of the consolidation plan of railway mechanical associations. I believe it means for the minor associations more helpful recognition from the larger associations, which in turn will lead to a better understanding and co-operation along the lines of economical standardization of locomotive parts and appliances. I am in favor of this organization delegating the chairman of the executive committee with power to advise and act with other executive chairmen of all mechanical organizations for the purpose of exchanging views on the subject with all concerned and at a time which will enable a report to be made in 1915.

W. W. SCOTT
President [illegible]

I would not advise any plan being adopted that would take away from any of the minor organizations their individuality.

In conclusion, I wish to thank the members of this association for their assistance and advice during the two years I have been your presiding officer. I also wish to convey to the supply men our appreciation for their efforts to make the International Railway General Foremen's Association the success it is. You stood steadfast when the clouds were dark, and the General Foremen are a grateful organization.

To the secretary and treasurer, Mr. Hall, the executive committee and [illegible] to you, gentlemen, for your good work, and, in behalf of this organization, we thank you.

[illegible]

[illegible] of this association were at the time the Eleventh Annual Convention was held: W. W. Scott, president; L. A. North, first vice-president; Walter Smith, second vice-president; W. T. Gale, third vice-president; W. G. Reyer, fourth vice-president; William Hall, secretary and treasurer.

On the second day of the convention the election of officers for the ensuing year was held, which resulted in the raising of L. A. North, first vice-president to the position of president and the advancing of all the other officers one step.

VALVE AND VALVE GEARING

The executive committee and the secretary greatly facilitated the work of the convention by having all the committee reports printed in advance. There were five committee reports, all of them displaying great construction and research; one of them, on valves and valve gearing, being the most voluminous reports we have ever seen submitted to railway mechanical conventions. That report contains over 40,000 words and is illumined by 44 illustrations. Walter Smith was chairman of the committee that prepared this splendid report.

The report is divided up into sections that deal with particular parts or phases of locomotive action and give excellent opportunity for discussing details. There are nearly 200 of these divisions.

When the preliminary work of the convention was finished the regular business was taken up with the discussion of the reports. No attempt at reading each report as a whole was made, but they were taken up section by section, and there always seemed some member ready to comment upon the subject under discussion. A striking feature about the proceedings was that there never appeared lulls of silence so tiresome at many mechanical conventions.

The opening paragraphs of the report indicate the aims of the investigation proposed by the committee. They read: The size and weight of locomotives have been increased to the apparent limit, and it is now the consensus of opinion that greater increase in capacity and speed must come from other sources. The possibility of further improvements in steam distribution have been recognized, and at the present time no part of the modern locomotive is the subject of so much study, discussion and experiment as the valve motion.

It is true that the large engines do not develop a draw bar pull at high speed at all proportional to their size, when compared with the smaller engines. This is probably due to the fact that the present valve gears do not take care of the large cylinder volume now being used, and the cylinder passages are not suitably designed to allow the locomotive to run at high speed at fairly long cut-off. In the last few years, however, important improvements in exhaust nozzles and exhaust passages in the saddles have been developed, and this with the increased capacity derived from the use of superheated steam has covered up the defects in steam distribution to a certain extent.

It is a well known fact that the boiler limits the maximum horse power, but we can easily see that the valve gear exercises restrictions at high speed that cannot be neglected.

Then follow a mass of paragraphs—Modern Practice; Economy in Locomotive Operating Steam Action; Valve Events; Distribution Valves; Piston Valve Versus the Slide Valve; the Allen Slide Valve; the Wilson High Pressure Slide Valve; the Miller Double Acting Slide Valve; and so on.

The merits of the various valves are exhaustively discussed and a great deal of valuable information is given on the different forms of valves in use. We have long been students of valve development, but we must confess that this report contains a great deal of information that is new to us. Others who are interested in the design and operation of valve gears will find this report of material help, for the descriptions are remarkably plain but in many cases are made clear by good illustrations.

The so-called "Stephenson" valve gear, which was first put into practical working condition by William Williams, has received detailed attention that will prove useful for both designers and valve setters. The same thing may be said of the Walschaerts, the Baker, the Southern, and the Young valve gears. The information concerning the Walschaerts gear is particularly profuse. Besides these there is quite a treatise on reverse gears, the Ragonnet being very clearly described, while the Mellin and the Casey-Cavin reverse gears are clearly described.

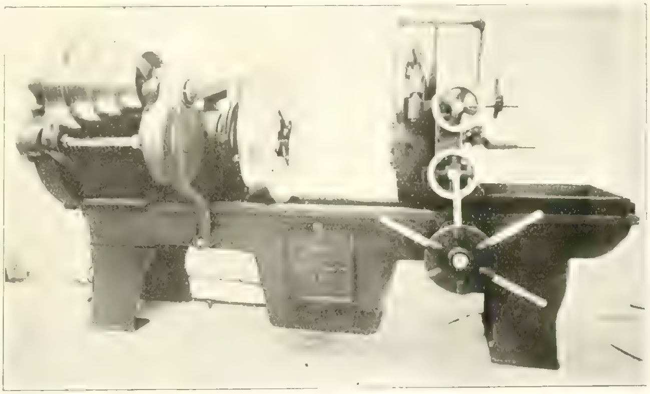
The members of the association displayed wonderful industry in discussing the various reports during a session of four days. They manifested as much interest in making their Eleventh Annual Convention a success as they display in getting through their daily work.

Landis Pipe Threading and Cutting Machine

Landis Machine Company, Waynesboro, Pa.

The Landis Machine Company, Waynesboro, Pa., has recently developed and placed on the market a line of pipe threading and cutting machines, which are attracting world-wide attention. These machines are designed to use the well-known Landis stationary type pipe die heads which cover an exceptionally wide range with but one set of chasers. They are massive in construction and are equipped with the most improved mechanical and safety attachments. The gripping chucks have universal adjustments and on the 4-inch and 6-inch machines are lever operated.

The Landis chasers are milled from flat bar steel and are hardened their entire length. It is unnecessary to anneal, hob or retemper them. The flexible rake and the natural clearance between the serrated face of the tool and the surface of the work, eliminate all unnecessary friction at the cutting edge and make it possible to operate at a very high speed. Landis chasers will outlast all others from ten to twenty times. Those belonging to the 2-inch head can be used for both right and left hand threading; but as the chaser holders of the 4-inch head are incorporated in the head, this size is limited to right hand work.



LANDIS PIPE THREADING AND CUTTING MACHINE.

The most noteworthy feature of this type of machine is the ease with which it may be adjusted for the different sizes of pipe. This is due to the fact that the die head and gripping chuck have universal diametrical adjustments, and that but one set of chasers is required to cover the range of each die head.

These machines are fitted with reaming attachments and cutting off tools and will thread, ream and cut pipe in one continuous operation at a speed double that possible on any other pipe machine. Several of these machines have already been placed in service in some of the largest pipe shops in this country and are giving excellent satisfaction.

Primitive Screw Making.

Screws are still made in India just as they were made originally, by winding two soft wires together around a mandrel. The wires are then carefully separated, and one of them is soldered into a tube or nut while the other is soldered to a short rod. All the silversmiths make their screws in this way, and they are all left-handed, for they are wound over and over by the right hand. Screw-bolts and screw-presses were introduced by Europeans, and for many years all the cotton exported from India was compressed by a massive screw of wood, turned round by cattle yoked to a long lever. This screw may still be found in remote districts. It is cut entirely by hand, and is set out by winding two ropes around the hand-dressed beam to give the pitch.

Soft Tools for Driving.

For driving bolts and keys and straps and other work about machinery a babbitt or lead hammer is better than a copper hammer, which hardens the more it is used. To keep the lead hammer from getting out of shape, take a piece of copper pipe, iron pipe size, drill a hole in one side of it and fit with a handle, and then fill in the hollow of the copper pipe with lead. Even better than the lead hammer are hardwood blocks on end. Put against part to be driven, and strike with a hammer. For driving stub end of connecting rods on large engines back and forth when keyed up, use blocks about 5 inches square and 3 feet long.

Fireless Locomotives.

There are many industrial occupations where the conditions are extremely dangerous, thereby rendering the question of economic intermovement of materials somewhat difficult. The transportation of materials in explosive depots is an interesting illustration of this problem. The issue has been solved, however, in a great measure by recourse to fireless locomotives. As the designation implies, the locomotives conform to the general design, but are not provided with a fire or heating device of any kind. Instead there is a reservoir or boiler, which is filled partly with water and partly with high pressure steam. The latter is pumped into the boiler from a steam-raising station outside the danger zone, to which the locomotive is taken from time to time. The construction of this type of locomotive has been brought to a high standard of perfection in Germany, the leading locomotive manufacturing firms specializing in this class of engine; while certain American manufacturers also have devoted their energies to the same problem. In Great Britain the possibilities of this form of transportation have been appreciated, and are receiving greater attention. The admiralty recently acquired a locomotive of this type for use in the explosive danger zones. The engine is able to run for several hours upon one charge of steam, and, owing to the system of heat insulation adopted, the locomotive may be left standing for a period of twelve hours in the open air without appreciable loss of energy. The engine is easy to handle; in fact it is operated in exactly the same manner as the ordinary locomotive, except that firing is eliminated. The control is precisely similar. Not only is the engine fireless, but all the rubbing faces, such as the brake-blocks and the impact-points represented by the buffers, are rendered sparkless by the use of special facing materials. These engines have been extensively adopted in dangerous mines where access to the workings is provided by gradients instead of shafts.

Why the Locomotive Is Called "She."

"Why," asked the fat passenger, "does the engineer always call his engine 'she'?" [illegible] said something about "her headlight," which was followed by a hollow groan all along the line. "Because," ventured the tall, thin passenger, "the more you throttle her the faster she goes." But this was barred out under the rules. The man with the sample case suggested: "Because she runs the mail," but everybody said, "Ah, there!" so sarcastically [illegible] said: "Because there was so much bustle [illegible] cigars for the crowd on the spot. The bashful passenger said maybe it was because she "pulled the smoker," and he was hissed off the stage, and longer had they sung, but the woman who talks bass closed the lodge by croaking: "Because we couldn't get along without her."—BURDETT.

Electric Headlights.

The Southern Pacific Railroad has been using an electric headlight operated from storage batteries with success. The high efficiency tungstein light makes this possible. A nitrogen-filled tungstein lamp of 140 candle power rating is mounted in the standard oil lamp reflectors. Each headlight takes 13 amperes at 6 volts, and is connected to a 300 ampere hour lead cell storage battery, which is capable of furnishing energy to the headlight, 3 cab lights and two "blizzard" lamps for 13 hours. The battery is mounted on top of the boiler, and is removed when engine is laid up for charging.

Railways in Great Britain.

The returns of the British railways for the year 1913 show that in that year there were 40,689 miles of line open for operation. Of this but 23,718 miles, or 59 per cent, was single track. The return does not divide this into English and Welsh, Scottish and Irish, but taking the returns for 1912, where it is divided, as a basis, it is found that 33 per cent. of the English and Welsh, 58 per cent. of the Scottish, and 80 per cent. of the Irish are single-track lines.

Baltimore & Ohio.

The Baltimore & Ohio has placed contracts for equipment which will cost approximately $2,500,000. The order calls for 2,000 steel hopper cars and fifty cars for passenger service. The hopper cars will be built by the American Car & Foundry Company at East St. Louis, Ill the Pressed Steel Car Company at Pittsburgh, and the Cambria Steel Company at Johnstown, Pa. The order for passenger service cars was placed with the Pullman Company at Chicago, and included thirty-five coaches, five combination passenger and baggage cars, two baggage and mail cars, four baggage cars, two café parlor cars and two café coaches.

Learn to Spell.

[illegible] are constantly receiving letters ad[illegible] editor [illegible] names wrongly spelled, asking for fa[illegible] friends. In this morning's mail there are two letters, one from a Cornell man, asking for employment on editorial staff, the editor's name in both instances being misspelled. The fact that men holding important positions have names different from John or Thomas may be hard on illiterate blockheads, but the blockhead cannot expect to receive favors when he writes so that his ignorance is made manifest.

To Re-Cut Old Files.

Dissolve four ounces of saleratus in one quart of water and boil the files in it for fifteen minutes. Then wash and dry them. Prepare in a glass or stoneware vessel one quart of rain water and slowly add four ounces of sulphuric acid. Immerse the files in this solution, and then wash them clean. Dry rapidly and treat with sweet oil. Coarse or rough files should remain in the diluted sulphuric acid for twelve hours, and fine files should be allowed to remain from six to eight hours. The solution can be used many times with good effect, and the files may be re-sharpened several times by this process.

The fools who sit on the fence and sneer get nothing but their sneering for their pains. Anybody can carp. Anybody can snipe. Anybody with the least possible mentality can find fault with human nature and human work. Nothing is so easy and so worthless as to gibe at our fellowmen.

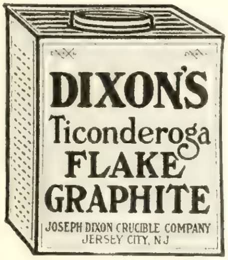
One of the best ways to attract and interest other people is by going about one's own business as though it were the most wonderful and fascinating thing in the world. People soon begin to look on wistfully, begin to wonder what all this activity and triumphant joyousness is about, and are presently drawn to it as bees are drawn by a blooming clover field.

Yesterday is gone, and it is a pretty good plan to forget and dismiss its worries, profiting only by the experience and knowledge it gave you. Tomorrow never comes, so there seems to be little sense in worrying about it. But today is here, and if you're wise you will make the best of it.

The youth gets together his materials to build a bridge to the moon; or, perchance, a palace or a temple on the earth, and at length the middle-aged man concludes to build a woodshed with them.

In life there is no creature so degraded but knows full well which is the noble and beautiful thing he must do.

The "teeth of friction" can't bite if you lubricate with—



There's only one way to get perfect lubrication and that way is to eliminate the "teeth of friction," the minute imperfections which, in even the most highly finished bearing surfaces, show, under a microscope, like hills and dales. Oil or plain grease are only transitory lubricants, subject to the whims of load, pressure, climatic and other conditions. Flake graphite, unlike oil or plain grease, is not squeezed out by pressure, but is forced upon the tiny projections—"the teeth of friction"—the flakes become pinned and form over the surface a most marvelous veneer-like coating, unctuous and wonderfully smooth. Dixon's Flake Graphite will improve the efficiency of the oil or grease that you are using. Thousands of expert engineers all over the world have proven this to their satisfaction. Why not write for sample No. 69-C and prove it to your own?

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RAILROAD NOTES.

The Buffalo Rochester & Pittsburgh is inquiring for 900 steel underframes.

The Seaboard Air Line is reported in the market for about 100 machine tools.

The Eureka Nevada has ordered one Prairie type locomotive from the H. K. Porter Co.

The Santa Fe has been figuring on getting a number of tools for its shops at Cleburne, Tex.

The Belgian State Railways have ordered 20 locomotives from the American Locomotive Co.

The Chicago Rock Island & Pacific has ordered 3,000 tons of rails from the Algoma Steel Corporation.

The Intercolonial Railroad of Canada has been getting prices on 20 locomotives, also on 1,000 box cars.

The San Pedro, Los Angeles & Salt Lake has contracted with the Colorado Fuel & Iron Co. for 8,000 tons of rails.

The South African Railways have ordered 6 small narrow-gauge locomotives from the Baldwin Locomotive Works.

The Lima Locomotive Company has taken orders for 64 locomotives from France and 50 locomotives from Russia.

It is stated that the Russian government has let contracts for 350 locomotives in this country and 50 in Canada.

The Central Railway of Brazil has placed an order with the American Locomotive Company for six locomotives.

The Gulf, Florida & Alabama has awarded contract to the American Bridge Company for 750 tons of steel for bridges on its new line.

The National Steel Car Company has received an order for 1,300 railway cars for the French Nord line, amounting to about $1,250,000.

The Chicago & North Western has ordered two observation-lounging and three observation-buffet-lounging cars from the Pullman Company.

The Pennsylvania has ordered 155,000 tons of steel rails, a portion of which are to be 125-pound rails, the largest ever made for steam roads.

The Frisco System has ordered 21,212 tons of heavy rails for relaying on the main lines; also has ordered considerable steel for bridge construction.

The Santa Fe is installing a mechanical coal chute at Albuquerque, N. M., and one at Florence, Kan. Also building a seven-stall roundhouse at Prescott, Ariz.

The H. K. Porter Company, Pittsburgh, has orders from the Russian government for 33 locomotives. The engines are small, 22 being of 72 tons each and 11 of 67 tons.

The Havana Central has ordered 100 30-ton box cars and 10 30-ton cabooses from the Standard Steel Car Company. Orders have also been placed for 50 30-ton flat cars.

The French government has placed orders in this country for 2,500 freight cars, and for 1,000 in Canada, and is reported to be inquiring for prices on 345 passenger cars.

The Toledo-Detroit has placed an order with the American Locomotive Company for two consolidation freight locomotives. The cylinders will be 21 x 28 inches, driving wheels 56 inches, and weight 160,000 pounds.

The Western Maryland, according to report, has decided to install a block signal system on 50 miles of its main line in Maryland, and the signal work is thereafter to be continued until the entire line is so equipped.

A large part of Russian rail order has been placed. The Cambria Steel Company has taken 100,000 tons and the Lackawanna Steel Company 60,000 tons. The original inquiry from Russia was for between 350,000 and 400,000 tons.

The Southern has started work on electric automatic block signals covering 77.5 miles of the Washington-Atlanta line as follows: Orange and Arrowhead, Va., 36 miles; Elma and Amherst, Va., 18.5 miles; Whittle and Danville, Va., 23 miles.

The New York Public Service Commission, first district, will enter the market for about 35,000 tons of open hearth rails, 3,000 tons of manganese rails, 1,000,000 tie plates, 356,000 yards of broken stone and ballast and about 30,000,000 feet of ties and timber, to be used in the subway system.

The United States government has consented to the construction of the proposed rapid transit bridge over the Bronx river at Westchester avenue, New York. This bridge is to carry the tracks of the Pelham Bay Park branch of the Lexington avenue subway, which, at this point runs on an elevated structure. The plans call for a permanent bridge with a [illegible] water. The engineers of the public service commission for the first district are preparing plans.

Books, Bulletins, Catalogues, Etc.

MacRae's Blue Book.

Since the consolidation of MacRae's Blue Book with The Railway Supply Index-Catalogue, the new edition has not only assumed larger proportions but a more complete classification of the names of the various manufacturers of railway supplies. Of these there are over 9,000. The catalogue section, consisting of the catalogues of the various manufacturers, are collated in condensed form. Among other admirable features are a comprehensive trade index, a net discount computer, and what is unique of its kind and greatly needed—a section giving the standard list prices of railway materials. Of much value also is a miscellaneous data section, full of information for railroad officials. The book extends to 1,400 pages. The paper and presswork and binding are of the best. Advertisers are furnished with one copy of the work free. Others are charged $10. Address MacRae's Blue Book Company, Railway Exchange Building, Chicago, Ill.

Steam Boilers and Combustion.

In the Broadway Series of Engineering Handbooks, Volume XV, by John Batey, furnishes an excellent treatise on Steam Boilers and Combustion, the chief merit of which consists in its practical applicability to every day service. Unfortunately, most of the books published on such subjects are highly technical and repel the ordinary working engineer. The work before us is of engaging interest and incites ingenuity to throw off all restraining trammels, and enlists the reader, if opportunity arises, to try and stop the tremendous waste that is now going on in the majority of steam plants. Eighteen diagrams illumine the work, which extends to 210 pages. The typography, binding and letter press work are in the usually high order of excellence of the publications of the Messrs. Scott, Greenwood & Son, London, England. The D. Van Nostrand Company, 25 Park place, New York, are the American agents. The price is $1.50 net.

The Ford Car.

The construction, operation and re- [illegible] model T Ford car are fully [illegible] volume of 288 pages by Victor W. Page, M.E., and published by the Norman W. Henley Publishing Company, 132 Nassau street, New York. There are nearly 100 illustrations, and any one having a [illegible] should [illegible] this book. The mastery of the subject is easy and complete, and there is no other motor vehicle sold in sufficient quantities to warrant the publication of a special treatise. Most of the cars being operated by people who have not had opportunities of obtaining a wide mechanical knowledge, this book is just what they need. The bare and brief maker's instruction pamphlets are good, but Page's work is infinitely better. It is sold at $1 per copy.

Railway Mail Pay.

A very interesting booklet, entitled, "What the Railway Mail Pay Problem Means to the Railroads," has been compiled for the information of the executives of railways, and is now republished with the resolutions adopted at the conference held at New York last May. The proposed changes in the present iniquitous laws are discussed. The gross injustice to the railroads are pointed out. The incapacity of legislators to deal fairly with railroad questions is so flagrant that it has become insufferable, and in no country of the world is there so much work done for so little remuneration as is done by American railroads. It is high time that the solution of the railway mail pay problem should be placed in the hands of the Interstate Commerce Commission, for while it is generally believed that that body could be improved upon, it has not shown itself to be so utterly devoid of common sense as is the average member of Congress or the average Postmaster General.

Safety and Short Trains.

Mr. Marcus A. Dow, general safety agent of the New York Central lines, appeared before the House of Representatives at Springfield, Ill., last May, and delivered an able argument against the "Short-Train" bill introduced there. The address is now published in pamphlet form, and is well worthy of perusal. As is well known, efforts have been made in several states to enact laws limiting the length of freight trains, in order to increase safety. Mr. Dow claims that a train limit would increase rather than decrease the accident hazard. Whatever may be the merits of the [illegible], we would [illegible] suredly place our reliance on the findings of the [illegible] of the [illegible] committees [illegible] leading railroads, rather than on the findings of the members of the Illinois or any other legislature. The average legislature is not to be trusted. The safety committees are doing excellent work, and it would be interesting to hear [illegible] as well as from [illegible]

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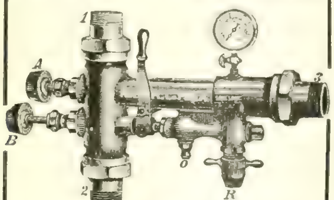

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accomplished and versatile chairman of the [illegible] York Central lines.

Porter Steam Locomotives.

The H. K. Porter Company, builders of locomotives, has just issued the eleventh edition of their illustrated catalogue. These successive editions have grown in importance and interest until, instead of being a mere catalogue it has become a text-book on locomotives, and it is in many ways the most unique work of its kind ever published, containing engineering and technical information found nowhere else in print. While the book is a trade catalogue and intended for engineers, superintendents and master mechanics of industrial plants, coal mines, logging roads and contractors generally, the book is too good and costs too much to prepare to be distributed indiscriminately among people not interested. To these copies of the book will be furnished at $1. As is well known, the Porter specialty has been light locomotives, but gradually the enterprising firm has perfected the designing of heavy locomotives. As a sample of the company's growth, the first edition of the catalogue, which was issued in 1874, described 17 locomotives. The present edition describes 673 locomotives, including some as light as 3 tons and as heavy, including tender, as 190 tons. The catalogue is not only a record of success, it is a proof of it, and a prophecy of further triumphs. Application for copies should be addressed to the company's main office, Union Bank Building, Pittsburgh, Pa.

Results of Electrification.

The above is the title of a most attractive booklet issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. In the course of seventy-two 7 x 9½ pages the story of what has been done in the electrification of railways is impressed upon the memory of readers in a most alluring manner. Every page contains one or two illustrations of electrified railways, the engravings being masterpieces of the engraver's art. To go slowly over the pages of the [illegible] most varied records in the kinds of vehicles that combine in the highest degree comfort and luxury, the means of rapid transit being complete. An eloquent foreword of the volume says:

"The electric locomotive is no longer an experiment in its application to steam railroad operating conditions.

"Its first introduction into the [illegible] was somewhat compulsory, with the [illegible] the steam locomotive. Its application has, however, proven conclusively that for reliability of operation, economy in maintenance, flexibility of control and availability for service, it is superior to the steam locomotive. In development it has kept pace with the recent rapid advance of the steam locomotive, until today single electric locomotives are being designed with axle loads of 65,000 pounds and continuous capacity ratings of 4,000 horsepower."

Readers wishing to secure copies of this attractive book should apply to J. C. McQuiston, Department of Publicity, East Pittsburgh, Pa.

Booklet About Graphite Brushes.

Operators of electric power machinery are interested in the subject of commutation and are fully aware of its importance in the electrical field. A large percentage of breakdowns in the present-day motor or generator must be charged against improper operation of commutator and brushes. Graphite brushes are designed and marketed with the express purpose of reducing commutator troubles to a minimum. A booklet, "Dixon's Graphite Brushes," explains how the characteristic lubricating qualities of graphite are utilized to this end. The entire booklet is recommended to your careful consideration, especially page three, where the advantages of graphite over carbon as a brush material are clearly set forth. An electrical service department for the solution of brush problems invites detailed statements and will advise whether Dixon's Brushes are adapted to the stated operating conditions. Frequently trial orders have made enthusiastic supporters of graphite brushes. A copy of the booklet may be obtained free upon request from the Joseph Dixon Crucible Co., Jersey City, N. J.

Staybolts.

The Flannery Bolt Company, Pittsburgh, Pa., in their monthly digest furnish valuable information in regard to the use of their products. It has been found that several railroads that have adopted a complete Tate bolt installation for certain types of fireboxes, have also found smaller installations giving entire satisfaction in other fireboxes, all depending on the proportion or ex- [illegible] and [illegible] far as possible afford that free- [illegible] the company's interesting monthly may [illegible]

Locomotives for Plantation Service.

[illegible] Baldwin Loco- [illegible] different de- [illegible] suitable for plantation service, with descriptions. These vary in type and capacity from light, [illegible] suitable for [illegible] hauls, to [illegible] consolidation [illegible] for road ser- [illegible] been built for narrow gauge tracks, and are of un- [illegible] of the [illegible] are built to gauges and templets, duplicate parts can be readily furnished by the builders which are guaranteed to fit in place. It is interesting to note the variety in gauges of these locomotives running into nearly a dozen varieties from 1 ft. 10 [illegible] standard gauge.

Why the Silica?

[illegible] gold chain will not prove a durable chain. Neither will a pure all-graphite paint prove a durable protective covering. The copper alloy in a fourteen or sixteen karat chain insures durability. The silica of a silica-graphite paint adds durability and supplies just enough "drag" to prevent too thin a coat. Neither graphite or silica alone provides so good a pigment as do both combined. Nature's own mixture [illegible] mation in which the two are intimately attached has proven itself to be the best form of pigment because, unlike other forms where free silica is a constituent, the silica does not separate itself from the graphite and settle into a hard mass. Silica should be mixed with the graphite so that particles of each cling to the other [illegible]

Railway Notes.

[illegible] way Motors," a treatise on the ventilation of this type of motor by R. E. Hell- [illegible] the Westinghouse Electric & Mfg. Co. This paper is a reprint of an [illegible] this most important subject. A large [illegible] practice in ventilating motors, together with diagrams showing the air currents through the windings and cores of the armatures.

The treatise is altogether a valuable [illegible]

The Autocrat at the Lunch Table.

This is the title of a book of [illegible] by Bruce V. Crandall and published by the Railway Educational Press, [illegible] Building, Chicago, Ill. The matter consists of a series of articles that appeared in the [illegible] and have been rewritten and revised to appear in the proposed more permanent form. [illegible] which have been held over many lunch [illegible] may naturally [illegible] the [illegible] better business [illegible] this, if it cannot do any good it will not [illegible] are excellent. Price, $1.50

[illegible] any other collector.

Travel Comfort.

[illegible] tion which he avers took place between a young man and woman who were seated [illegible]

"Yes, love," came the reply.

"There is no draught on my little angel face, is there?"

"No, dear love."

"And you don't feel any jolts?"

"None whatever, joy of my life."

"Then change seats with me."

'Tis not in the high stars alone,
Nor in the cups of budding flowers,
Nor in the red-breast's mellow tone,
Nor in the bow that smiles in showers,

There always, always something sings.

A High Priced Ticket.

Possibly the most valuable ticket ever issued by a Transportation Company was that issued on July 2 by The Chesapeake & Ohio Railway to the "Richmond Blues," covering their journey to the Pacific Coast, one ticket being issued covering the movement of 185 men, the value being $17,800.

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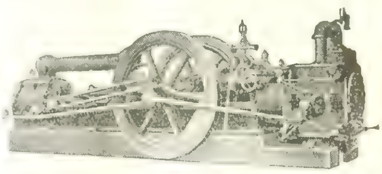
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Railway and Locomotive Engineering
A Practical Journal of Motive Power, Rolling Stock and Appliances
Vol. XXVIII. 114 Liberty Street, New York, September, 1915. No. 9

Heavy Hauling on the Baltimore and Ohio Railroad

The accompanying illustration is a reproduction of a photograph showing a heavy freight train on the Connellsville division of the Baltimore and Ohio railroad. The train, which is known as Number five, is ascending Salt Lick Curve near Fairhope, and about twenty miles from Cumberland, Md. Two powerful while the degree of curvature on the left of the illustration is 7 degrees 35 minutes, while the curve on the right is 6 degrees 34 minutes. It will thus be observed that the tractive power required on this grade and curves is over 80 pounds per ton, the larger half of which is taken up on account of the grade. The weight of engine was built at the Schenectady Works in 1904, and weighed 334,500 pounds. From this engine the others of this type were subsequently modeled, the only additions of new features being in the application of superheating attachments and some of them with stokers. A general increase in size and weight has

[illegible] FREIGHT TRAIN ON SALT LICK [illegible]

Mallet locomotives, No. 2,422 in front, and No. 2,431 in the rear, are required to move the train up the steep grade. The tractive power of each is over 105,000 pounds; of the thirty-five coal cars composing the train the actual tonnage amounts to 2,596. The grade at the point shown is 2.4 or about 126 feet per mile, each engine is 468,300 pounds and the weight of the engine and tender together amounts to 642,500 pounds.

It is interesting to recall the fact that this type of locomotive was first introduced in America by the construction of a Mallet for the Baltimore and Ohio by the American Locomotive Company. [illegible] [illegible] going on, the cylinders of the first Mallet used on the road being 20 and 32 by 32 inches. In the two engines shown in the illustration the cylinders are 26 and 41 by 32 inches, and with a steam [illegible] 210 [illegible] that while the high pressure main valve [illegible] the piston variety, the low pressure

valve is a large [illegible] ported D slide valve having [illegible] exhaust clearance [illegible] valve travel and a 1-inch steam lap. The high pressure valve has the same travel, 1-inch steam lap and an exhaust clearance of 5-16 inch. The setting of the high and low pressure valves is with a constant lead of 3-16 inch. The [illegible] inches of 100 square feet. The services rendered by these engines have been of the most satisfactory kind, and it would be difficult to maintain the growing traffic in the hilly country through which much of the road passes, without the services of these [illegible] locomotives.

Crossing the Williamette River, and on the Overland Fair Limited at the Panama-Pacific Exposition

Last month we took occasion to describe briefly the nature of the work in railroad construction through the Deschutes Canyon in Oregon, a work unique in its kind in having two railroads run along the banks of the Deschutes river through rocky gorges of almost inaccessible wildness. Many other remarkable engineering accomplishments have been achieved in Oregon. Among these, the

RAILROAD BRIDGE ACROSS THE WILLIAMETTE RIVER IN OREGON

bridge across the Williamette river, a tributary of the Columbia river, is among the largest works of its kind. As is well known the negotiation of a busy waterway is always beset with many peculiar difficulties, especially when the crossing has to be made in the vicinity of a flourishing port. Where the banks are low- [illegible] respected. The width of the river demanded a huge steel bridge, but as it was impossible to elevate the structure sufficiently to enable large vessels to pass upstream, a movable span had to be introduced. After the subject had been fully investigated it was felt that a swing bridge would meet the situation most effectively. The bridge itself measures 1,762 feet in length, and is divided into five spans carried upon massive masonry piers. The central is the draw span, and in order to meet local requirements, it has the tremendous length of 521 feet, which renders it the largest of its type in the world.

A visitor from the East to the great Panama-Pacific Exposition, no matter what route he goes or returns [illegible] sees many great works in railroad construction which in themselves are a spectacle in some respects surpassing the clustered wonders of the Exposition. In this connection it may be added that one of the most delightful experiences to the traveler is a trip on the Overland Fair Limited, along the water front, and during [illegible] Exposition buildings pass in glorified review and with the still lagoons reflecting the pillared and turreted wonders of the sculptured palaces, together with the silvery sheen of the bay beyond encircled by the dark hills, makes a vision that could not be matched either in its gorgeous outline or exquisite setting.

[illegible]

Encouraging Uruguay Central Railway Men.

Another active step, promoted particularly by the general manager of the Uruguay Central Railway, Mr. C. W. Bayne, is that of offering prizes to the employes of the railway for suggestions tending [illegible] be constant evidence both of the prizes given and of the character of the suggestions. The last publication of this kind contained 161 ideas, so called, of which 8 were given prizes, and the improvements offered in these suggestions were adopted by the railway company as of practical value.

The railroad that we refer to is of the narrow gauge type and the coaches as shown in the illustration are of the open kind and are very liberally patronized by the visitors who in the Golden California air seem to have a preference for being conveyed from place to place by one or other of the many varieties of wheeled conveyances, among which are the auto trains that ply through the busy avenues. These highways are smooth as burnished jasper and it is not surprising that the easy running trains of cars are constantly crowded with the delighted visitors.

Electrification on the Illinois Central.

Electrification of the Illinois Central in Chicago is being planned in connection with the great terminal for which that company is rushing plans and specifications. The design for the station provides for three track levels. The cost of this improvement will be $15,000,000. The layout for the levels disclosed the electrification scheme which is necessitated by the fact that it is impossible to build a viaduct to the new lake front at one point, and steam operation for triplicate levels is not deemed practicable. The work will be proceeded with [illegible]

Railway Extensions in Nigeria.

In no portion of West Africa has the progress of railway construction been more rapid or had more effect upon the development of the "hinterland" than in Nigeria. The system of railroads, which is controlled by the British Colonial Government, now extends nearly 800 miles into the interior. The ocean terminus is at Lagos, the capital and great commercial port of the colony, which has a population, including the suburb of Ebute Metta, of about 76,000, the number of white inhabitants being 600 to 700. A large wharf has been built at Iddo, a short distance from Lagos, for loading and unloading freight, and it is here that the warehouses and docks are established.

V[illegible]W OVERLOOK[illegible] [illegible]NE ART BUILDING, LAGOON AND BAY [illegible]

Lima Locomotive Works Busy.

In less than three months the Lima Locomotive Corporation, Lima, Ohio, has received orders for 54 locomotives, among which are the following: Fifteen Mallet-type locomotives for the Western Maryland Railway; 25 consolidated-type for Pennsylvania Lines West; eight Mikado-type for Denver and Salt Lake Railroad; one 42-ton Shay geared locomotive for the Angelina County Lumber Co., Keltys, Tex.; one for the Mountain Copper Co., Mococo, Cal.; another for the J. W. Veness Lumber Co., Winlock, Wash., and a fourth for the United States Gypsum Co., Raco, Mich.; a 70-ton Shay for the Yosemite Valley Lumber Co., Merced, Cal., and a 28-ton Shay for Morley Cypress Co., Morley, La.

The extensive additions to the works are filled to their capacity.

Australian Railways.

The proposal for the [illegible] railway from South Australia to Brisbane has been under discussion and the commonwealth has been strongly approved of. This scheme embraces a railway covering a distance of 2,018 miles from Perth to Brisbane, the sections being Perth-Kalgoorlie, 375 miles, Kalgoorlie-Port Augusta, 1,063 miles, Port Augusta-South Australian border, 210 miles, South Australian border Wentworth, 50 miles, Wentworth-Mt. Hope, 220 miles, Mt. Hope-Goondiwindi, 400 miles, Goondiwindi-Millmerran, 70 miles, and Millmerran-Brisbane, 160 miles. The new line would mean that 1,020 miles would be built, in addition to finishing the uncompleted portion of the transcontinental railway. The work includes a complete standardization of the track.

The Railways in China.

China's railways in general are showing satisfactory balance sheets and several [illegible] rolling stock in order to care for the gradually increasing traffic in goods and passengers. Already cars, locomotives, etc., are being ordered, the importations for 1914 showing an increase of over 50 [illegible]

High Time.

S[illegible]rty-five engines of the Oregon S[illegible] Line that were whiteleaded and [illegible] two years ago have been ordered [illegible]

An Introduction to the Study of Air Brakes

By WALTER V. TURNER, Assistant Manager Westinghouse Air Brake Company

Part III—All the Brakes in a Train Should be Considered as One. Greatest Safety Device Ever Known but Many Irregular Operations Occur from Lack of Care and Understanding

[illegible] the wheels [illegible] slid under a car that has been running for a long time with no trouble of this kind, do not conclude that this car has too much braking power, for the trouble is probably due to the fact that the other cars in the train at this time are not braking as high as they should—thus the tendency of the properly braked car to stop more quickly than those under-braked permits them to pull or push it forward and thus causing the wheels to "pick up." These examples illustrate why it is so necessary to consider all the brakes in the train as one.

While the expression "flow" is often used in connection with the movement of air, it should be understood to mean expansion, for air differs from a liquid to which the term "flow" is generally applied, in that it is compressible and, therefore, when under pressure will expand in any direction in which there is an opening, and yet the vessel from which it expands or flows will still be full of air, while if a vessel is full of water and some of it is allowed to flow out, the vessel is no longer full of water for it has practically no expansive property. It is the tendency of the air to expand that produces at one and the same time the movement of the parts of the brake system and the change of pressure, though it does not follow because the pressure has been lowered that the air is less in amount, for it may be due to an increase in volume; in other words it is not pressure that passes from the different receptacles of an air brake system, but air, and the increase of pressure in the receptacle to which the air passes is due to the increase in the amount of air therein, and will be great or small according to whether the volume of the [illegible] with the chamber from which it expands. That is, [illegible] that [illegible] in the one for any given decrease in the other; thus, if the piston travel is long, the brake cylinder volume is greater than when the piston travel is short and there- [illegible] that reservoir pressure the brake cylinder will not increase to what it will if the piston travel is short, yet the same amount of air passes to the brake cylinder in each case [illegible] becomes less in amount when some of it [illegible] about by enlarging its volume by adding to it the volume of the brake cylinder, temporarily when making a partial application, permanently during a full application. When the air has done the work required of it in the brake cylinder, it is permitted to escape to the atmosphere and its place in the system must be supplied by air from the compressor.

No work is performed by the air in retarding or controlling the train until it reaches the brake cylinder, when it forces the piston out. To this piston, the levers, brake beams and brake shoes are so connected that the shoes are forced against the wheels creating friction between the wheel and the shoes, antagonistic to the adhesion of the wheel to the rail, thus dissipating the energy of the train and reducing its speed, or, as in grade work, preventing the accumulation of energy by not permitting the train to accelerate. The levers are not only used to transform the fluid pressure in the brake cylinder into a mechanical force, but to multiply it and this multiplication varies between predetermined limits, it being necessary because of this multiplication to provide for proper shoe clearance by fixing a standard brake piston stroke in the design.

From what has been said, it will be seen that there are four elements involved in every brake operation, namely: 1st, time; 2nd, amount of reduction or change of pressure in the brake pipe; 3rd, amount of cylinder pressure obtained; and, 4th, percentage of braking power. Only one of these is fixed, viz., the percentage of braking power. That is, a given pressure in the cylinder gives a certain braking power; all the rest is variable. For instance, the time required to reduce the brake pipe pressure a certain amount is varied by increasing or decreasing the length of the train because this changes the volume of air in the brake pipe.

The amount of reduction required to obtain a given cylinder pressure is varied by the ratio of the reservoir to the brake cylinder and the cylinder pressure obtained from a given decrease in reservoir pressure is varied by the ratio of the brake cylinder to the reservoir, which ratio is varied by an increase or decrease of piston travel, as this in effect increases or decreases the size of the brake cylinder.

Plainly, then, all these elements must be kept in mind when considering any problem involving train control, and it is only by knowing the relationship ex- [illegible] the cause of the results obtained can be deduced.

Not only does the foregoing enable us to understand the air brake, its operation, the causes of any irregular operation, and the necessity of proper operating conditions, but it proves that any system founded on these principles must operate. There remain, however, the question of intelligent application of these principles, durability, simplicity and capacity to meet all conditions, and it is in these that the equipment considered in this book is supreme. Still no mechanical apparatus is so good as to be perfect and it is therefore a foregone conclusion that many irregular operations of this equipment will occur, brought about by neglect, wear and tear, and lack of understanding on the part of these concerned in its care and operation. What will cause irregular operation of this equipment will do the same with the other equipments; in fact, conditions that will make the old brake system very inefficient, and, in some cases, valueless, will have little or no effect on this. Therefore if anything goes wrong (?) with this equipment, do not assume off-hand that the equipment is at fault, for it is probably reflecting improper operation or showing up the effect of "man failure" somewhere. Besides, blaming the wrong thing will never supply the remedy, while, if the true cause be found, it can be removed.

In conclusion, I would like to impress upon all the importance of the air brake, for it is at once the greatest safety device ever known, the most profitable investment the railroads have, tremendously increasing the earning capacity, and is the best friend the engineer and trainmen have ever had, consequently, it behooves all to be vitally interested in obtaining the proper knowledge of it, to learn how it should be manipulated and what is most important of all, that it should be properly cared for and maintained, and I may add that no one can ever attain a satisfactory and efficient working knowledge of the air brake until what is said in these papers becomes second nature to him.

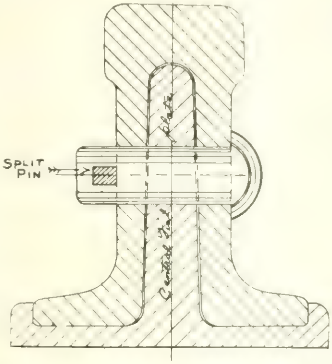
There is a tendency among the railroad men to under-estimate the importance of the air brake which should be guarded against, as there is a hesitancy in asking questions. The reading of railroad literature should be encouraged, and the superiority of RAILWAY AND LOCOMOTIVE ENGINEERING in the Air Brake Department is especially marked.

The Steel Rail Puzzle

BY WILLIAM H. WOOD, M. E., Media, Pa.

Present Form of Rail not Properly Balanced. Double-Webbed Rail Suggested

Mr. A. W. Gibbs, mechanical engineer of the Pennsylvania Railroad, delivered an address on the subject of the "Steel Rail Puzzle" at the recent annual convention of the American Society for Testing Materials. That some of the steel rails now rolled are satisfactory is evident from Mr. Gibbs' statement, that if all the rails were as good as the best there would be very little room for complaint. This statement applies to all merchandise, as well as men. I note great stress is made in regard to the material and its chemical proportions. However good the materials entering into the construction of rails may be, they will not stop the rail from breaking, from the fact that the nature of all metal is subject to deterioration. My experience as a mechanical and constructing engineer for the past forty-five years has been to design, by formation, machinery and other parts pertaining thereto, which is subject to violent shocks, millions of blows, expansions and contraction, to prevent depreciation of the materials by crystallization, such as is produced in steam engines, steam hammers, hydraulic machinery, marine and loco boilers, etc. The same would apply to the formation of the rail, which as now used is not of a balanced construction; this, together with its being fastened directly to the ties, prevents, to a large extent, the release of the vibration which produces crystallization, by the million of blows given to it by the heavy engines and cars passing over them. This with the torsion stresses produced by curvature in the road will cause



SUGGESTED DOUBLE WEBBED [illegible]

the rails to break, and the breakage will occur mostly with low temperature in winter, due to excessive contraction.

The present top section and the web of the rail used is no doubt the same as that used in England, with the exception that the English rail is the same top and [illegible] tom, which gives a balanced formation; [illegible] cast-iron chair and secured by a wooden wedge, its life would be much longer, for the reason that the vibration is better released, whereas our rail is directly fastened to the ties. The former retards crystallization, while the tendency of the other does not; therefore, the breaking of rails is not going to stop or be solved by the question of materials, but its life may be made considerably longer and with less danger by a change in formation. Some fifty years ago, when rails were used in England, securing them directly to the ties, as in our case here, a section of the rail used was altogether different, being made with two webs and two flanges. The formation of it was no doubt made to prevent the very cause which is so prevalent with the single web rail used here, namely, breakage.

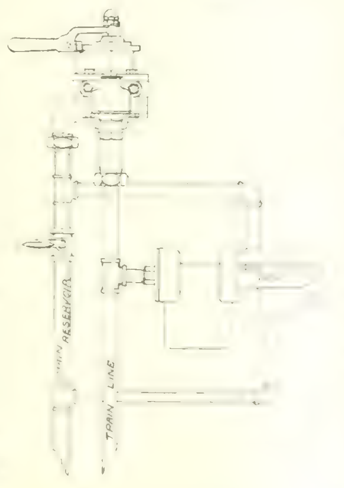
It will be admitted [illegible] rail, if it could be used, would divide and release the vibration, preventing crystallization and makes a stronger rail because there would be double the surface to the webs over these at present used, and to a great extent this would prevent rail breakage by prolonging its life. Enclosed is a sketch of a rail with a central fish plate for a "safety first" kind of rail which is [illegible]

Improved Double-Heading Valve

By WM. R. DAVIS, Road Foreman of Engines, New York Central Lines, Columbus, Ohio

New Attachment to the Engineer's Brake Valve

I note in your issue of July, 1915, just received, that you have an inquiry from "F. A.," Queensland, Australia, for some information on my Double-Heading Valve, which was described in your issue of January last, in which there was a mistake relative to the operation of the valve. I enclose a drawing showing the improved construction of the double-heading valve, the improvement being for the convenience and maintenance of the valve, as the actual operation of the valve remains the same. I may advise that we have had this valve in test operations for some time and find it works perfectly, as described below: This valve is to be connected under the engineer's brake valve, with a cut-out cock in the main reservoir pipe to the engineer's brake valve, so the attachment to the main reservoir pipe leading to the engineer's valve is made at the half-inch opening, so that when the first engineer releases the brake the high pressure in the train line [illegible]



right, allowing air from the main reservoir of the second engine to flow through the valve to the train line. When the first engineer makes an application and reduces the train line, the pressure in Chamber 65 forces the piston toward the weaker pressure, or to the left, closing the valve between the main reservoir of the second engine and the train line.

In order to insure the safe reduction of pressure of air coming from the main reservoir of the second engine, this air is passed through the engineer's brake valve and slide valve feed-valve, thus being positive that it is reduced to standard train line pressure and not depending wholly on the reduction spring in Cham- [illegible]

[illegible] two metal packing rings and the rest of the valves have rubber seats. The body of the valve is of cast iron, with bronze [illegible]

Handling Grates as an Aid to Combustion

By A. E. SCHEETZ, Shamokin, Pa.

Interesting Experiences With Various Railroad Men

In reading the article in a recent issue on "Relation of Grate Area to Combustion," it prompts me to unfold some experiences I have had as a fireman. I fired on one of the largest systems in this country. We had pool engines and regular engines, both freight and passenger. Our engines were equipped with the regular finger-shaking grates, and they gave satisfaction if a fireman would use his head at all, he could regulate the supply of air almost to perfection by cocking the grates to suit the way the engine was drafted and the kind of coal that was furnished, thus causing complete combustion. It would be very hard to install grates that would furnish the proper amount of air through the grates to burn all kinds of coal. If only one kind of coal was furnished it would not be such a task. I know that one engine that was known on [illegible] that had had the road tied up day after day for the [illegible] the good luck to get this engine on several occasions and on one of them I don't think that ever an engine up to that date made a better run with so heavy a train. They may [illegible] that they will [illegible]

[illegible] to be gained by the sectional shaker finger grates. If the engine burns the fire too hard in the front and the back grates are cocked it [illegible] the draft or the opposite, if drafted too hard behind. Often times it can be changed and equal- [illegible] you have often wondered why it is that you have two or more engines of exactly the same type drafted alike in the smoke box, same size nozzle and they do not burn their fire alike. One may burn it hardest in front, the other in the back, and another on the sides or middle. Why all this difference, when the draft gear is exactly alike? I claim the difference is because there is more air space in that section of grate where it tears the fire the worst, and to overcome this seemingly hard task, put grates in that the fireman can control. To get complete combustion there must be sufficient air and not too much. A general fixed design would have trouble overcoming the conditions of weather, draft, and different kinds of coal. Build the ash pans so as to supply plenty of air all over the bottom of the grate surface and keep pans clean, especially over wheel covers if a wide firebox. Educate the fireman and teach him how to use his head with the shovel. But don't forget also to teach the engineer how to keep water in the boiler, how to work an engine so as to use the steam expansively and learn the road. I don't believe anyone could keep an engine hot for some engineers while for others there is no trouble.

I fired regular for one man a little over a year. He was not just the nicest fellow in the world to get along with, but I got on to his ways and we became fast friends. This very fellow was, to my opinion, about the slickest man at the throttle on that division of close to 200 engineers. No matter what old engine we got he would take his train without a grumble and get over the road in less time than anyone else could. He was never heard grumbling about the power, but when he got to the engine house he would make out his report (of actual work that should be done in justice to the engine) without any fuss. He worked his engine to an advantage, he used the steam as expansively as it was possible to do under conditions, and had a perfect system of keeping water in the boiler, always at one spot, unless for grades, when he would vary to suit the grade, and always before we struck it.

On the other hand, I fired for another fellow for about the same length of time. He was of a different disposition, easy to get along with. He could tell every tree along the pike, show where he had shot turkeys and deer, and where trout fishing was the best. But he could no more run an engine to advantage than fly. He simply could not work an engine. He didn't know the first thing about carrying water and further, he did not know the road. Once he would have her barreled up to the neck, then down to a gauge. Bif-bang-on, bif-bang-off, would go the injector. Once you would fire furiously to keep her warm while he was loading her up, then after he had her loaded, with a big, hot fire, you could see your hard work going out through the pops in streams until she was down again. Then about this time you would strike a grade, no fire, no water. Ah me, talk about air through the grates, yes, but educate your engineers. This same fellow would fuss around every engine, whether good or bad, make a big ado when he arrived at the engine house, and his reports didn't amount to fiddle strings. An engineer should also be able to make intelligent reports when turning engines over at terminals, so that what is necessary to do should be done.

Rotating Mechanical Stoker

By S. H. DUNNING, Paterson, N. J.

Referring to the article published in the [illegible] ENGINEERING in regard to a rotating stoker recently invented by me, permit me to state that my aim was to design a stoker that would successfully feed fuel into a locomotive firebox and that can be installed much cheaper than those hitherto in use. My design is much simpler and consists of a much smaller number of parts and a greater degree of efficiency and durability might reasonably be expected from its operation than from those heretofore submitted. It is not to be wondered at that the railroad companies have not become particularly interested in mechanical stokers, because so far such devices have not proved to have the [illegible] fuel which is one of the [illegible] for by the [illegible] companies.

The device which I have perfected [illegible] able saving [illegible] first cost but also a minimum cost in mainten[illegible] that the parts [illegible] not only few in number but are so constructed that the system of water circulation prevents the parts that are necessarily exposed to the action of the fire from rapid deterioration. These facts are not in themselves, I am well aware, the factors that make an opportunity for a fair trial possible, and it is a singular circumstance how difficult it is to get even a chance to show the merits of an invention. The railroads are so hampered by legislation on the one hand and a desire of gain on the other that there is no time or inclination to try new experiments. The efforts of those in authority are spent in keeping down expenses, while those in charge of the mechanical departments have more than enough to do in keeping the wheels turning with such devices as they already have on hand, and have no time even to look at a new device, and, of course, no desire to give it attention. I am not without hope, however, that with the kindly aid already liberally furnished by the leading engineering journals that the device may in the near future receive a fair trial and have its merits thoroughly established.

Comments on the Value of a Locomotive

By WILSON E. SYMONS, Superintendent of Motive Power of the San Antonio & Arkansas Railway

A Locomotive Should not be Considered as an Element in Establishing Rates

At a recent meeting of the Western Railway Club, a very valuable paper was read by Mr. G. S. Goodwin on "The Value of a Locomotive." The paper was too heavily loaded with statistics for our columns, but a very interesting discussion of the paper was prepared by Mr. W. C. Symons as follows:

In speaking of the value of the locomotive, the subject can be approached from many angles, as the term "value" is, to say the least, an ambiguous one in its general application, and when applied to a locomotive it seems that the angles of vision increase.

The question of value, or valuation, as applied to railway property, involves, in its broadest sense, many features, some of which do not enter into the subject under discussion, while others do.

The courts of last resort have decided that a fair value of anything used as a medium of barter, trade, sale or exchange, is such price as may be agreed upon between a willing buyer and a willing seller, and in any transaction predicated upon the foregoing fundamental principles, the element of depreciation would be recognized.

In speaking of the value of a locomotive as an integral part of a complete transportation unit, however, the element of depreciation is not considered as it would be in the case of making a purchase of a locomotive that had seen some service. This, for the reason that a railway company, as a complete transportation unit, is organized, equipped and operated for the purpose of rendering a given service in the transportation of freight and passengers, and in rendering this service the character, or quality, of the service is to be considered, rather than the intrinsic value of certain integral parts of the complete transportation unit. To make this point clearer, it can best be illustrated by a [illegible] example. A passenger purchases a ticket over a trunk line for a journey of 500 to 1,000 miles, selecting a train the published schedule of which best meets his requirements for the journey. In passing over one locomotive district the train may be handled by a new locomotive which cost, say, $25,000, but owing to its being new and not thoroughly free from possible delays, resulting from breaking in or operating new power, the train may fall behind its schedule some twenty or thirty minutes. At the end of this locomotive division another engine may be attached which originally cost less money and may have been in service eight or ten years, and in passing over the district on which this engine handles the train, the schedule may not only be maintained, but the lost time recovered, so that a locomotive with an intrinsic value of about half of that of the one which caused the delay will be the medium through which the schedule is restored. Again, it is not infrequently the case that over certain districts of a railway the management elects to renew or make additions to their passenger equipment by building and placing in service a complete new passenger train. This sometimes includes a new locomotive. Some months later another, or companion train, running opposite, is also replaced by [illegible]

WILSON E. SYMONS

This equipment thus relieved is demoted to a less important run, or the branch service.

From these examples, or illustrations, I wish to bring out the point that the value of a locomotive, or any other integral part of a complete transportation unit, should not be considered as an element in establishing either freight or passenger rates. It is a service which the carrier provides that should be paid for, and as a fundamental principle the return from both freight and passenger business should be sufficiently adequate to maintain the entire property in first-class physical condition, and to yield a fair interest and dividend rate to the holders of the securities, and with a sufficient surplus in the treasury at all times to meet unusual emergencies, such as unprecedented floods, etc.

About eight years ago I had occasion to prepare some statistical data with reference to the earning capacity of freight cars and locomotives, on 36 of the prominent trunk lines of the United States. The yearly earnings of the locomotives ranged from $25,000 per year to as high as $86,000 per year, or an average for the 36 lines of over $51,000 per engine per year. Again in 1910, in making a report on one of the coal-carrying roads in the Ohio district, I made an estimate of the average earning capacity of locomotives on 20 lines in that territory. These earnings varied from $23,000 to $48,000 per year, or an average of somewhat over $40,000. These figures were obtained by taking the total freight earnings shown in the companies' published reports and dividing this sum by their number of freight locomotives, which did not take into account the engines that are ordinarily in the shops and those which are in work train service, so that if proper allowance were made for these two items it may safely be said that the figures given would be increased as much as 15 to 20 per cent. In the first estimate, made in 1907, the number of locomotives involved was about 37,000, which in the second the number was [illegible]

With reference to the question of depreciation which I have touched upon, I think it proper that I should, in a general way, define my position, so that my remarks with respect to the value of a locomotive may not be misconstrued or misunderstood.

First, as a fundamental principle, depreciation of such portions of any property that are affected by time and service should be recognized in the company's capital account by writing off an amount equal to the lessened life, or usefulness, of the property in question, and this amount kept in reserve so that at the expiration of its life the scrap value, plus the amount in the reserve fund, would equal the first cost, or purchase price. By this plan, or system, the integrity of the company's capital account will at all [illegible]

The amount of depreciation to be written off, however, cannot in my opinion be definitely stated in a percentage that would be applicable to the different classes or property of all rail-

[illegible] is particularly [illegible] to locomotives, [illegible] cars and among the principal reasons why an arbitrary rule cannot be established is that the state of repair in which they are maintained is an important element, or controlling factor, in the question of depreciation. This point should be very [illegible] have personal [illegible] al condition of the motive power and rolling stock of different railways, and different classes of this character of property on certain individual railways. As an illustration, some of the American, or eight-[illegible] which handled main line passenger trains twenty [illegible] found on branch runs and in better physical condition than they were ten years ago, this by [illegible] new boilers, new cylinders and other important parts, so that in many instances it is a complete new engine retaining its original number. Other engines of the same class, for which there was no branch line demand, possibly were scrapped years ago, while in other cases the locomotives bought of a certain design are found after a few years unsuited for the company's require-[illegible] of a change in the character of traffic, or other changed conditions that could not be foreseen at the time of their purchase. [illegible] an exception [illegible] is clear that in disposing of power of this kind the [illegible] be quite an important one in so far as it affects the preservation of the company's capital [illegible]

[illegible] rate of depreciation on locomotives. I would [illegible] purposes [illegible] financiers contemplated furnishing funds to purchase locomotives under an equipment trust plan, wherein the locomotives were held as property of the Trust [illegible] would name a rate of depreciation of about 15 per [illegible] two [illegible] After that a reduced rate, possibly about [illegible] ity for the debt, the depreciation on them should be predicated upon such a basis, that if it became necessary for the Trust Company to foreclose and dispose of the engines they could be [illegible] would protect the Equipment Trust Company against any loss. This should not be construed, however, as an indication that the intrinsic value of the locomotives to the railroad company has de-[illegible] and probably have not, depreciated more than 3 per cent., but it is a well-known fact that a second-hand article, if sold under the hammer, as it were, must be disposed of at a sacrifice.

As a general proposition the depreciation of locomotives written off the company's books as the means of preserving the integrity of its capital account would probably average about 3 per cent., which gives the engine a life of about 33 years, although on many lines where the equipment is kept in a high state of repair (which is indicative of a liberal return of earnings to the upkeep of the property) a much less amount should be written off. And in questions of rate-making no depreciation whatever should be considered.

There are a number of features in the matter of improvements and design that will materially add to the value of locomotives, although these might now, at this period, be classed as of minor importance, the locomotive of today having pretty well emerged from the experimental field, as it represents the combined engineering thought of the motive power officers and locomotive builders of America.

Such questions as better inspection at end of run, material supply, roundhouse facilities, water treating, and modern repair shop facilities, all more or less affect the value of a locomotive from the standpoint of its earning capacity, and as railway managements not only recognize these features and make more liberal provisions in that direction, they provide means for increased value of the locomotive as an integral part of a transportation unit, for it not only makes it possible for the company to have the engine available for use a greater percentage of time, but it also adds to its efficiency while in service, and to a certain degree precludes, or at least minimizes, the possibility of failure while on the line.

Power of Knowledge.

A [illegible] the line of the locomotive cab, and [illegible] to the [illegible] one of our most important railways, which he fills with dignity and marked ability, remarked to the writer: "There is no mistake that the engineer is every day [illegible] important [illegible] son.

"When I was on the road the engineer [illegible] compared to that extended to the conductor [illegible] important train to be run, when the making of time was of unusual consequence, the best conductor on the road was selected, and upon him devolved the responsibility of getting the train along. If the weather was bad or snow deep, and unusual difficulties were looked for in getting trains over a division, the conductor was regarded as the man who would do the most in getting there.

"Since there came to be so much mechanism on locomotives and cars that the engineer alone is likely to understand, he is getting to be looked upon as the man responsible for everything connected with the safe and prompt movement of the trains. When there is anxiety to get a train through under difficulties nowadays, we never concern ourselves about who is conductor. If the engineer is a man whose record gives confidence we know that everything will be done that knowledge, judgment and ability can accomplish

"We have two or three conductors who know more about air-brakes, heating-pipes and valves, signals, etc., than the average engineer, and these men are valued accordingly. Knowledge is power, and to no class does this apply more practically than to railroad trainmen. A significant sign of the times is that you can hear young trainmen making fun of the engineer who does not understand all the details of train mechanism. These instances, however, are the rare exceptions and the engineers as a rule are not only keeping abreast of the time, but are showing a marked improvement in their acquisition of knowledge and in their reliability and integrity.

The Weak Hero.

The newspapers are fond of commending the engineer as a hero who remained on his engine and went down to death in the wreck. We have known several heroes of that kind, but experience taught us that it was not bravery but fear that prevented them from getting off. Our advice is—Try to stop the train if you have time, but get off quick. Meeting given death with your hand on the throttle lever is no honor. The wives and children of many a railroad hero of that character are in want of bread today. Be a hero to your own family and continue to hold the position of a bread winner.

Use of Graphite Brushes.

A rough and worn commutator will always produce sparking and not only cause annoyance and low efficiency during operation, but eventually make an extended and expensive shut down for necessary repairs. It has been found that graphite brushes are excellent for use upon commutators because they are free from grit and are self-lubricating. Many users of electric power machinery have adopted Dixon's graphite brushes, and results with them have been highly successful

Large Order for Decapod Type of Locomotives for the Russian State Railways

New Designs in Expansion Stays and Other Features

The Baldwin Locomotive Works is building 250 locomotives of the Decapod (2-10-0) type for the Russian State railways. Apart from the magnitude of the order, these engines are of interest because of their design and the urgency with which they are being constructed. Although the axle loads are light, as compared with American practice, the locomotives are of considerable capacity, as they exert a tractive force of 51,500 pounds. The ratio of adhesion, however, is unusually low. The locomotives are designed to haul 1,000 metric tons up a straight grade of 0.8 per cent., at a speed of approximately 8 to 10 miles per hour. This they should be able to do easily, while working at a fairly economical cut off.

While special materials and equipment are used to a considerable extent in the construction of these engines, the design is generally in accordance with the practice of the builders. The fuel used is a most inferior grade of bituminous coal, and this is burned on a rocking and drop grate with an area of 64.5 square feet. The firebox is placed above the driving-wheels, and is equipped with a sectional brick-arch supported on water tubes. The firedoors are pneumatically operated. The inside firebox is of copper, and copper stays are used in the water legs. The front end of the firebox crown is supported by three rows of expansion stays, which are of a new design recently introduced by the builders. The nut on the upper end of the radial stay is seated in a die-forged stirrup, which is screwed into the roof-sheet. After the nut has been adjusted to give the proper tension, the thread on the stay is set into the nut with a punch. This is a simple arrangement, which has ample flexibility and utilizes ordinary stay-bolt taps in the boiler and firebox sheets; while the water space above the crown is not obstructed, as is the case where T-iron stays are used.

These locomotives are equipped with Schmidt superheaters and outside steam pipes. The superheater is composed of 28 elements, with a superheating surface of 563 square feet. The steam distribution is controlled by 12-inch piston valves, which are arranged for inside admission and driven by Walschaerts' motion. The Rushton power reverse mechanism is applied. This device is operated by a small rotary air engine. It is exceedingly compact, and if necessary can be arranged, without difficulty, for manual operation.

The cylinders, frames and running gear closely follow American practice in design. Forty per cent. of the weight of the reciprocating parts is balanced, and careful attention has been given to making these parts as light as is consistent with the required strength. The pistons have rolled steel heads, with cast iron rings sprung in, and extended rods. The guides and crossheads are of the single bar type, following Russian practice in design. The front and back driving wheels have a total lateral play in the boxes of 7-16 inch, and the knuckle pins in the front and back side rods are fitted into spherical bushings to provide for lateral motion. The main driving-wheels have plain tires. This construction is necessary as the engines will be required to traverse curves of 350 feet radius.

In accordance with Russian practice these locomotives have

DECAPOD (2-10-0) TYPE OF LOCOMOTIVES FOR [illegible] RUSSIAN [illegible] RAILWAYS
Baldwin Locomotive Works, [illegible]

board with a railing around the outer edge. There is also a railing around the front bumper. The cab is of steel, and the front end of the tender is enclosed to protect the engine crew from the weather. The equipment includes Russian-Walschaerts' automatic air-brakes. The couplers and buffers are of course arranged in accordance with Russian practice.

The tender is carried on two four-wheeled trucks, which are of the arch-bar type, with rolled steel wheels. The frame longitudinal sills consist of 12-inch channels. The tender is of light construction, as it was important to reduce the weight where possible.

The principal dimensions of these locomotives are as follows:

Gauge, 5 ft.

Cylinders, 25 in. by 28 in.; valves, piston, 12 in. diameter.

Boiler—Type, straight; material, steel; diameter, 70 in.; thickness of sheets, 5/8 in.; working pressure, 180 lb.; fuel, low grade soft coal; staying, radial.

Firebox—Material, copper; length, 108[illegible] in.; width, 86 in.; depth, front, 69 in.; depth, back, 60 in.; thickness of sheets, sides, 1/2 in.; thickness of sheets, back, 1/2 in.; thickness of sheets, crown, [illegible] in.; thickness of sheets, tube, 1 in. by [illegible]

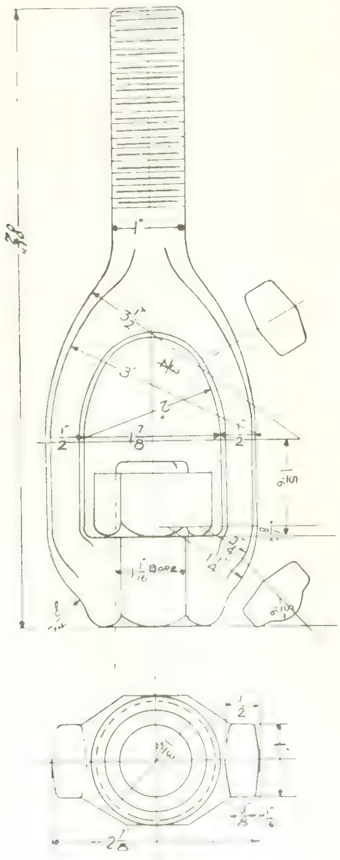
Tubes—Material, steel; thickness, No. 9 W. G.; number, 28; diameter, 5 3/8 in.; length, 17 ft.

Heating surface—Firebox, 181 sq. ft.; tubes, 2,393 sq. ft.; firebrick tubes, 27 sq. ft.; total, 2,601 sq. ft.; grate area, 64.5

[illegible] outside, 52 in.; diamet[illegible] journals, main [illegible] 12 in.; journals, others, $8\frac{1}{2}$ in. by 12 in.

Engine truck wheels Diameter, front, 33 in.; journals, $5\frac{1}{2}$ in. by 10 in.

Wheel base—Driving, 18 ft. 8 in.; rigid, 18 ft. 8 in.; total engine, 27 ft. 10 in.; total engine and tender, 60 ft. $1\frac{1}{2}$ in.



[illegible]

[illegible] 175,000 lb., on truck, front, 21,000 lb.; total engine, 196,000 lb.; total engine and tender, 328,000 lb.

Tender Wheels, number, 8, wheels, diameter, 36 in., journals, $5\frac{1}{2}$ in. by 10 in., tank capacity, 7,400 gals.; fuel capacity, 8 metric tons; service, freight.

[illegible]

Superheating surface, 563 sq. ft.

Laying Rails on the Lehigh Valley Railroad With Locomotive Cranes

[illegible] Lehigh Valley Railroad has [illegible] some remarkable results through its adoption of the practice of laying rails with locomotive cranes. The first tests were made on short strips of track. From the first, however, such good results were obtained and the possibilities for the expansion of the practice were demonstrated so thoroughly, the practice was continued where greater stretches of work had to be done. On July 15 the method was adopted as standard for the whole line.

Some of the remarkable results made by the cranes in laying rail, and at the same time throwing out the old rail, are well nigh astonishing. A stretch of rail between [illegible] and a point east of [illegible], New York, a distance of 4.07 miles, recently was laid with new 100-lb. rail in remarkable time. Four locomotive cranes were used, the track completed in every detail, including the laying of four turnouts, and the old rail picked up, together with all the other material down to the last nut lock in one day. The following records were made by the cranes in laying the rail, at the same time throwing out the old rail:

The first crane started work at 6:23 A. M., laid 345 rails in two hundred and sixty-seven minutes, including ten minutes detention. The second crane started work at 6:56 A. M., laid 363 rails in three hundred and thirty-five minutes, including five minutes detention. The third crane started work at 7:40 A. M., laid 338 rails in three hundred and five minutes, including twenty-eight minutes detention. The fourth crane started work at 7:45 A. M., laid 267 rails in three hundred minutes, including thirty minutes detention. The last new rail was laid at 12:51 P. M., and the track was entirely completed and the old rail and material fully loaded at 6:30 P. M. The loading of the old rail up to the time the new rail was laid was done with aid loaders following behind the forces completing the track. After the new rail had been entirely laid the three locomotive cranes [illegible] loading the old rail.

In laying rails with locomotive cranes the tongs gang was otherwise used, and the usual gang for throwing out the old rail was not needed at all. A locomotive crane with an operator, a foreman, and six men lays the new rail faster than it can be done with the usual gang of men. At the same time it throws out the old rail, making a saving of twenty laborers for every crane used in laying the new rail and loading the old rail with machines. No heavy work is done by the men, and they can work all day at the light work at top speed.

The Lehigh [illegible] as standard the practice of unloading all new rail with machines; laying it with locomotive cranes and picking up the old rail by machinery the same day. This will not only prove a great economy, but greater speed in doing the work will be made.

Back Cylinder Pressure and Compression.

We recently listened to a discussion on mechanical matters in a division room of locomotive engineers and we were much struck with the diverse views expressed concerning cylinder back pressure and compression. Most of the speakers confused these two pressure actions. Back pressure may be explained as pressure of live steam which opposes the movement of the piston owing to part of the steam failing to escape from the cylinder when the piston begins the return stroke. Compression results from the steam that remains in the cylinder after the slide valve closes and is the squeezing of that steam by the piston.

As soon as the port is closed, back pressure is supposed to cease and compression to commence. Compression is simply the confinement of steam in the cylinder squeezed into small volume by the momentum of the piston and other moving parts. Back pressure causes direct waste of heat and steam, while compression under proper restrictions heats the cylinder at the end of the stroke and gives out power that assists the steam pressure to be effective on the next stroke.

As action and reaction are equal, the compressed steam will give out in effective work, as much power as was used in producing it, less the friction, which is probably more than paid for by the generation of heat already referred to. No locomotive can be run [illegible] high speed without the [illegible] compression.

Oxy-Acetylene Cutting Torch.

There appears to [illegible] will withstand the tremendous heat of the oxy-acetylene cutting torch. It has melted lime, concrete, and other metals and minerals, heretofore considered absolutely fireproof. The latest is the melting of carborundum, the well-known grinding material, which stands 9.6 in the Mohr scale of hardness, and is only exceeded by the diamond, setting the standard at [illegible].

Not only so, but the variety of uses to which the oxy-acetylene torch is being applied is increasing in every conceivable direction, and its popularity bids fair to be of an enduring kind.

Catechism of Railroad Operation

Broken Frames, Crank Pins, Rods, Equalizers and Wheel Tires

Third Year's Examination.

(Continued from page 267, August, 1915.)

Q. 234.—Explain how you would handle engine with broken frame rails, ahead or back of main driver.

A.—The old rule is "with bottom frame rail broken at any place or top frame rail broken ahead of main box, do not try to handle any train unless you disconnect on the disabled side, and with top frame rail broken back of main driver handle train but do not work as second engine in double heading?"

Q. 235.—In case of broken side rods, what should be done? Why?

A.—Remove disabled rod or rods and the corresponding rods on the other side, becaues it is necessary to have side rods on both sides of engine so one side will help the other pass the dead center. NOTE.—With side rods up on only one side of engine, at time that side is passing center if main wheel should start to slip (or any of the wheels should be higher or lower than the other ones) the rest of wheels are as liable to turn the other way as they are to keep revolving in proper direction and pins or rods must break.

Q. 236.—What would you do if piston rod gland or valve stem gland broke?

A.—Cut two pieces of sheet iron or of an old scoop shovel, with slots that would go over studs and rod, slide one in from each side and tighten against gland, with the studs.

Q. 237.—What would you do if the intermediate section of side rod or main pin broke on "Brooks" consolidation engine? (Long main rod.)

A.—Take down all rods both sides, clamp valves centrally on seats, block crossheads, remove cylinder cocks and be towed in. NOTE.—Eccentrics are on No. 2 axle and main rod connected at No. 3 wheels.

Q. 238.—What would you do if stud broke in valve stem or piston rod packing gland?

A.—Would brace the gland if possible, if not, go right along.

Q. 239.—If metallic packing gives out on road and you have none to replace it what would you do?

A.—Wrap a piece of bell cord with candle wicking and pack piston rod or valve stem with it.

Q. 240.—If forward section side rod or front driving pin broke on Mogul engine what would you do?

A.—Take down all side rods and go in with one pair of wheels.

Q. 241.—If back section side rod breaks on Mogul or Consolidation engine, what would you do? Or forward section on Consolidation?

A.—Take down broken parts and the corresponding section on other side.

Q. 242.—If middle section side rod breaks on Consolidation engine, what?

A.—Take down all side rods both sides and go in with one pair of wheels.

Q. 243.—If main crank pin broke, what would you do?

A.—Take down all side rods, both sides, and main rod on the disabled side (or carry it in guides). Secure valve centrally on seat, block crosshead and remove cylinder cocks. NOTE.—Some types of engines are so constructed that crosshead bars will not clear pin on forward driver (with crosshead blocked). With this type of engine you will have to sling the forward pair of drivers and carry them clear of rail. To do this run both wheels up on wedges, block between pedestal binder and oil cellar and on top of frame under spring saddle to relieve weight, get off the wedges and counter balances will turn wheels so that pins will be on top eighths. As an extra precaution you may chain around spokes and across above frame rail, but it is not necessary.

Q. 244.—How would you relieve the weight from the journal on engines having large cross spring resting on top of driving boxes under frame rail?

A.—The only way possible is to run wheel up on wedge and block under box on top of pedestal binder.

Q. 245.—Do all Mogul and ten-wheel engines have knuckle joint in side rod, back of main pin?

A.—No, some types have the knuckle joint ahead of main pin.

Q. 246.—If forward tire was very loose or broken on a Mogul or Consolidation engine, how would you handle it?

A.—Run the disabled wheel on wedge to raise box as high as possible in the jaws, remove oil cellar and use two blocks between binder and journal (putting one on top of pedestal binder with grain of wood across binder and the one on top of it with groove cut for journal bearing on ends of grain of wood, furnish lubrication for journal with bar of soap, hard cup grease or oily waste) relieve weight from box by blocking between frame and spring saddle, cut out driver brake. NOTE.—If rods are not damaged do not take them down.

Q. 247.—What if main driving tire was very loose or broken?

A.—Run disabled wheel up on wedge to raise box as high as possible in jaws, remove the oil cellar, block on top of binder under journal, relieve the weight by blocking on top of frame under spring saddle, and cut out driver brake. NOTE.—If arch equalizers are used, block under ends of arch equalizers, on top of bottom frame rail. If underhung springs, chain ends of equalizers up to the bottom frame rail. NOTE.—You may have to take down binder to get oil cellar out.

Q. 248.—With intermediate driving tire very loose or broken, what would you do?

A.—Run disabled wheel up on wedge, remove oil cellar, block between binder and journal, relieve weight from box and cut out driver brake.

Q. 249.—With back driving tire very loose or broken?

A.—Run disabled wheel up on wedge to raise box as high as possible in jaws, remove oil cellar, block across pedestal binder and under journal block on bottom frame rail under ends of arch equalizer, or on top frame rail under spring saddle to relieve weight from box, block on top of the box under frame or on top of ends of arch equalizers under frame at wheel ahead of disabled wheel to throw the weight on these wheels diagonally, and carry engine up level, get off the block with disabled wheel and chain from back corner of engine frame on disabled side, across above draw bar, to opposite forward corner of tank frame, cut out driver brake and proceed. NOTE.—If impossible to carry weight diagonally, use a tie or piece of rail and lash it down to deck of engine and block under end on deck of tank, while the disabled wheel is on wedge, throwing weight on tank.

Q. 250.—What if forward driving wheel or axle broke on Mogul or Consolidation engine?

A.—Take down the necessary side rods and corresponding rods, jack or snub up the axle and handle same as for broken tire, except it is not considered necessary to remove oil cellar (merely block between cellar and pedestal, as the journal is ruined anyway) cut out driver brake.

Q. 251.—What if main wheel or axle broke?

A.—All side rods must be taken down. Handle journal same as above, clamp valve centrally on seat, disconnect valve rod, take out cylinder cocks and block crosshead ahead, carrying main rod in guides.

Q. 252.—What if back wheel or axle broke on Mogul or Consolidation engine?

A.—Remove back section side rods, both sides, and handle same as for broken tire, after you get journal snubbed up as high as possible. Cut out brake.

Q. 253.—What if axle or wheel broke in Bissel truck?

A.—With [illegible] down would [illegible] frame both sides, [illegible] front end of engine up and block on top of forward driving boxes under frame, remove disabled [illegible] tail."

Q. 25[illegible].—What [illegible] 4-wheel engine truck broke?

A.—Raise engine up in front to take weight off truck, raise disabled end of truck and chain truck frame at corners to engine frame above it, on both sides, block between boxes and engine frame rail [illegible] remove disabled wheels and proceed after brake is cut out.

Q. 25[illegible].—What if spring or spring hanger broke on 4 wheel engine truck?

A.—Raise engine in front, raise truck frame and block across on top of equalizers under truck frame as near the center [illegible].

Q. 25[illegible].—What if [illegible] wheel on 4-wheel engine truck?

A.—Raise engine in front, chain disabled corner of truck frame to engine frame above it and chain from disabled corner of truck frame to opposite engine [illegible] good wheel flange against rail, block on top of boxes at good pair of wheels, under engine frame. Cut out truck brake.

Q. 257.—What if equalizer broke on 4-wheel engine truck?

A.—Raise engine in front and place tie or rail from one box to the other, on disabled side over truck frame, blocking on [illegible] will clear cradle bars, then block on center of tie under engine frame, so truck may oscillate and not be rigid.

Q. 258. What if center casting, cradle hanger or cradle pin broke?

A. Raise engine in front and place ties or pieces of rail lengthways of engine across cradle bars, as near the center as possible.

Q. 259.—What should you do with broken tender truck wheel, flange or tread?

A. Would slide it if possible, or put tie on stay plates and chain disabled corner of truck up to it, get into the first siding and notify officials. NOTE: Wheel may be slid by using block of wood chucked between break in flange or tread of wheel and body of truck or hooking chain into core hole and wrapping it around axle opposite to direction wheel will turn, then [illegible] rail. Cut out brake.

Q. [illegible] in tender truck?

A. Sling both disabled corners of truck frame up to ties placed on stay plates, and remove the wheels when axle is broken. If journal is broken it will be necessary [illegible] stay plates also. You may block on top of truck boxes under tank frame at good [illegible]

Questions and Answers

Tractive Power of Three Cylinder Locomotive.

E. G., Camden, N. J., writes: Kindly advise how to calculate the tractive effort of a three-cylinder locomotive, all cylinders using high-pressure steam. Diameter of cylinders 16½ inches; length of stroke, 26 inches; diameter of driving wheels 6 feet 10 inches; boiler pressure 160 pounds.

A.—The formula would be as follows:

$$T = \frac{C^2 \times S \times 1.3P}{D}$$

where T = the rated tractive force at rim of driving wheels in pounds.

C = diameter of cylinder in inches.

S = stroke in inches

P = boiler pressure in pounds per square inch.

D = driving wheel diameter in inches.

Hence 16½ × 16½ = 272 [illegible] 26 = 7,078 [illegible] 208 = 1,472,328 [illegible] 82 = 17,955 pounds.

Again, by what is known as the civil engineers' method, 16½ × 16½ × .7854 = 212.725, area of piston in inches, multiplied by mean average pressure of steam, (.85 per cent. of boiler pressure) 136 = 28879.8 = pressure exerted by steam on one piston in pounds. Multiply by 3, for three pistons, we have 86638.8 × 4⅓ the stroke moved at a full revolution of the wheels = 375,434.8 divided by the circumference of the driving wheels in feet = 21.5 = 18,070 pounds.

Superheated Steam for Use in the Injector.

W. H. B., Leeds, England, asks: Could superheated steam, at 640 degrees Fahrenheit, be used for working boiler injectors, and would any economy result in using steam at this [illegible] temperature? A.—Steam could be used at the temperature referred to, but there would be no economy in its use, but some loss. Repeated experiments have shown that there is some economy in the use of exhaust steam in running the injector.

Unbalanced Locomotive.

[illegible] H. C., [illegible] writes: A twelve-wheel, 4-8-0, locomotive, with weight on the eight driving wheels amounting to 94,000 pounds, and weight on pony truck amounting to 39,900 pounds, and wheel base 14 feet 6 inches, has the disagreeable peculiarity of riding very rough. Would be pleased if you could advise whether this engine is properly balanced. A.—An engine of this type has frequently the disagreeable quality of excessive side pressure on the rails when [illegible] improvement on this particular experienced on the Mikado, 2-8-2 type, and Pacific, 4-6-2 type, where the bearing in the rear truck is of extra length and capable of as much side movement as will ever arise from the oscillation induced in curving. The excessive weight on the front truck referred to would have the effect of diminishing the tractive power of the locomotive, especially at starting. The total weight on the driving wheels of this class of locomotive should be at least 80 per cent.

Brake Fails to Apply and Air Pump Capacity.

G. H. P., Willow Glen, N. Y., writes: (1) Would you please tell me what could be wrong with the No. 6 E. T. brake, if it will not apply with the automatic brake valve in service position on the lone engine, but when coupled to a train of cars it would apply along with the train brakes? A.—Assuming that there is no manifestation of disorder beside the one you mention, the failure to apply indicates an uncharged pressure chamber of the distributing valve reservoir, presumably due to a restricted or closed feed groove in the equalizing piston bushing. Under this condition the brake on the engine may not apply after pumping up the pressure on the engine, but after coupling to the train sufficient time may have elapsed to permit the pressure chamber to become charged through the inevitable leakage past the equalizing valve piston packing ring, at which time the brake may be expected to apply through the use of the automatic brake valve and will continue to operate provided that ample time between applications permits of the recharge through the packing ring leakage.

(2) Are two 9½ inch air pumps of sufficient capacity for handling trains of from 70 to 85 cars, we have trouble in maintaining 80 lbs. pressure in the brake pipe and from pumps becoming overheated?

(3) Would it not be of advantage to have a separate line of pipe connecting the main reservoirs on engines when double heading so that the first could have the benefit of the pumps and main reservoirs of the second engine? A.—[illegible] pumps in good condition should be able to maintain 80 lbs. pressure in a reasonably tight brake pipe on 70 to 85 car trains for level track brake work, but as you are having trouble from pumps overheating it indicates that the pumps are not receiving the necessary attention or that excessive brake pipe leakage is permitted to exist. For grade braking, however, conditions are somewhat different as air consumption in handling a train of from 80 to 90 cars down

a 1 per cent. or 1½ per cent. grade, with the air brake, exceeds the capacity of two 9½ pumps, and should these be loaded or mixed loads and empties, the volume of compressed air required by recommended methods of brake operation would tax the capacity of two 11-inch pumps. For modern freight trains, the single stage compressors are generally conceded to be a thing of the past, and from many different points of view, hence they are being replaced with Cross-Compound and Duplex compressors.

(4) The separate line of main reservoir pipe and hose couplings between engines has been used to some extent, but is not of any particular benefit for the reason that when double heading the engines are usually pulling instead of braking, and when descending a grade where the benefits of the pumps of the second engine are desirable because of the length and steepness of such grades, there is generally but one engine on the train.

Defective Distributing Valve.

C. B. C., Harrisburg, Pa., writes: I have been puzzled by the peculiar action of a distributing valve, which with a 5-lb. brake pipe reduction makes a terrific noise which sounds as if it were going to tear itself off the bracket. The reservoir gauge hand vibrates rapidly and in about two seconds the noise stops and the proper pressure is obtained in the brake cylinders, and upon a further reduction nothing unusual is noticed. This does not occur upon every application, but when it does it is accompanied by a blow at the distributing valve exhaust port, the valve has been cleaned and oiled and the application piston spring is in good condition, but this trouble continues. Could you tell me through the columns of your valuable journal where to look for the cause of this trouble? A.—The noise you hear is made by the application piston of the distributing valve being thrown from application position back to release position at the rate of several hundred times per minute due to too rapid a flow of brake cylinder pressure past the collar of the piston into the application cylinder bushing. A neat fit of this collar in the cavity in which it operates is relied upon to prevent the disorder you mention, therefore it follows that the original size of the collar has been reduced possibly by wear, but much more likely by some one filing it through a mistaken idea of what constitutes intelligent repair work. Provided that the cavity has not been materially enlarged, applying a new application piston of full size will prevent the action you mention, however it should be known that the exhaust valve spring is not missing and that the application piston spring is standard and of correct tension.

Defective E. T. Brake.

H. J. B., Rocky Mount, N. C., writes: On an engine equipped with the No. 6 E. T. brake, with the brake valve handle in running position the brake pipe and main reservoir pressures equalize at 120 lbs. the adjustment of the maximum governor top, but when the brake valve handle is placed on lap position after a reduction the brake pipe pressure does not increase. The brake valves and feed valves have been removed and replaced by ones that were repaired and tested, but it has not overcome the trouble. Could you tell me how to locate the trouble? A.—The action you describe indicates that there is a leak from the main reservoir into the feed valve pipe which of course does not show on the air gage when the handle is on lap position, and if the feed valve has passed the test on the shop rack and the feed valve gasket is perfect, see that the feed valve pipe bracket is piped correctly, that is, that a crossed passage bracket is not piped for a direct passage bracket, or if a direct passage bracket is used, see that the piping is not arranged for a cross passage bracket. If this is known to be correct, test the feed valve bracket for a casting flaw and examine the diaphragm of the excess pressure governor top for leakage through the diaphragms which will very likely disclose the source of the trouble. A rough test for a flaw in the bracket may be made by closing the reservoir cock and removing the feed valve, then with the brake valve on lap position open the reservoir cock wide enough to create a blow at the feed valve bracket, then by holding the finger over the supply port a blow from the other port will indicate a casting flaw. Very slight leakage will be expected, however, due to the flow from the brake valve rotary to the feed valve pipe when the brake valve handle is on lap position.

Compressor Stopping in Service.

A. W. B., Mt. Clements, Mich., writes: What are the principal causes for the cross-compound compressors stopping in service. A.—Lack of lubrication in the steam portion, a gummy deposit of sediment of super-heater oil on the main valve structure, badly worn steam valve mechanism in combination with low steam pressure or combined with a blown out upper or lower steam cylinder gasket, and there is a possibility of a stoppage due to the blowing out of an air cylinder gasket between the high and low pressure cylinders.

Broken Down Compressor.

A. W. B., Mt. Clemens, Mich., writes: What are the principal causes for a break down with the cross-compound compressor? A.—The cross-compound compressor is amply prot... break down up to the point where the steam valve mechanism and the high pressure steam piston rings are actually worn out. With the advent of the oil tempered air valve and the taper fit of air piston on the rod, failures have been practically eliminated, or at least to such an extent that a failure is invariably due to careless workmanship, or an utter lack of air pump test or inspection. The only actual engine failure due to a broken cross-compound compressor that has come under our observation was due to the repairman failing to replace the cotter key in the main valve bolt allowing the nuts to work off the bolt and disconnect the piston.

Defective Compressor.

A. W. B., Mt. Clemens, Mich., writes: Where would you look for the trouble in a cross-compound compressor when it is lame and draws in no air on the down stroke and all the air valves are apparently in good condition? A.—In the piston rings of the low pressure air cylinder. Very loose and worn out rings with one-half of the cylinder dry frequently sets up such a condition, that is on one stroke the rings will stay against the walls of the cylinder and on the next stroke the compressed air may get between the rings and the wall of the cylinder on the dry side and all of the compression will escape past the rings to the other end of the cylinder.

Tempering Reamers.

A good way to harden a long reamer without warping is to suspend the reamer and tongs by a twisted string, and when the reamer is heateed properly, hold it over the tub suspended perpendicularly by the string in one hand, holding it from turning with the other. When ready let go and allow it to revolve rapidly and dip at the same instant. Reamers or taps hardened in this way will remain straight.

Lubricating Reamers.

Taper fluted reamers are strangely apt to chatter and refuse to cut, and after sticking fast, portions of teeth jerk out. Engine oil and lard oil help some but not much. The best remedy is a mixture of tallow and flake graphite. It works like magic. Any old, toothless, out of round, elliptic, hand-ground reamer works smoothly, and the teeth remain as enduring as the teeth of time.

Drilling Compound.

In drilling tool steel, such as dies, use a compound made of one pound of common soda to four quarts of water and one quart of machine oil. Let it stand for about half an hour, and it will be ready for use.

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The Traveling Engineers' Convention.

The [illegible] of this month to railroad men is the twenty-[illegible] of the Traveling Engineers' Association, which will [illegible].

Ever since the Traveling Engineers' Association was organized in the office [illegible] January 9, 1893, it has been celebrated for the important subjects reported upon, [illegible] the reports, for the exhaustive manner in which the investigations were carried out, and for the familiar scope of the discussions that followed the reading of the reports.

The declared objects for which the association was formed was the im-[illegible] service of American railways, through the advancement of knowledge concerning the duties of the traveling engineers, by discussions in common and exchange of information on subjects interesting to its members and of value to the railway companies, thereby making the work in all branches more systematic and efficient for the members and their employers, and to provide an organization through which these purposes should be systematically carried out. They also expressed their intention of attending a banquet offered by Sinclair & Hill, publishers of LOCOMOTIVE ENGINEERING, where the preliminary steps of the association could be discussed.

Those who were familiar with the condition of locomotives generally and the care bestowed upon them before the Traveling Engineers' Association was organized will readily admit that the efficiency of railway motive power and the comfort of the enginemen were decidedly advanced by the work done and the influence exercised by the Traveling Engineers' Association. Many organizations have been formed and are in operation for the purpose of promoting the efficiency of railway men and railway appliances and with intimate knowledge of the working of all railway associations we do not think that any of them have done so much good as the Traveling Engineers' Association.

The success of all industrial associations depends very much upon the character of the leaders and organizers in the beginning of its history. The Traveling Engineers' Association was very fortunate in its first officers, C. B. Conger having been president, and W. O. Thompson, who still holds the office, having been its first secretary, and D. R. McBain treasurer. Mr. Conger was re-elected president for five successive terms. During part of that time he was in the employ of the Angus Sinclair Company, traveling all over the country, which he utilized for calling upon all the traveling engineers and road foremen of engines who came within his reach; he worked very persuasively in urging all who were eligible to join the Traveling Engineers' Association. This led to rapid increase of membership so that in his opening address at the fourth annual convention President Conger remarked: "We started in New York with 53 members. There were 107 on the roll at Chicago in 1893, which number was increased to 134 at the Denver meeting in 1894, and 151 at the Pittsburgh meeting last year." Others took the lead so successfully inaugurated by Mr. Conger and helped to increase the popularity of the Traveling Engineers' Association till now the membership at the time of last convention was 1,027.

The subjects reported on and discussed by the Traveling Engineers' Association have always been highly practical and calculated to increase the information of the members. The first meeting held in the office of LOCOMOTIVE ENGINEERING was devoted to organizing and to the choice of officers. The work laid out for the succeeding convention was:

1. The economical use of oil and supplies.
2. Examination of firemen for promotion.
3. How can engineers improve the service when engines are double crewed?
4. What are the best methods for instruction of men for safe and practical handling of air-brakes in all kinds of service.
5. Testing of coal in actual service.

The reports on these subjects were all remarkably interesting and led to floor discussions equal in value to anything engaged in by practical railroad men. The reports submitted to the succeeding twenty-one conventions were all of a highly practical character and were a credit to the experienced officials forming the organization. The proud motto of the association is "To Improve the Locomotive Engine Service of American Railroads." We might safely add "It is second to none."

The subjects to be reported on and discussed at the coming convention are:

1. What effect does the mechanical placing of fuel in fireboxes and lubricating of locomotives have on the cost of operation?
2. Recommend practice on the employment and training of new firemen.
3. Difficulties accompanying the prevention of black smoke.
4. Advantages of the use of superheating. How can the traveling engineer improve the handling of air-brakes.

There are also four personal papers.

Shorter Hours.

Eight hours a day is enough to be engaged in mechanical toil requiring all the physical strength of the body and much of the intellectual energy of the mind. Anything beyond that is drudgery. That our grandfathers worked fourteen hours a day was their misfortune. They were paying the penalty of feudalism, the successor of barbarism, and the debt is not yet fully paid. The world is moving steadily onward—astronomers say towards the great star Lyra—philosophers say towards human equality. Both may fall short of having their visions realized, but in the meantime it is comforting to observe that the shortening of the hours of labor is being steadily accomplished.

The machinists, and more particularly railroad machinists, are near the tail end of the procession. It is not easy accounting for this because there is no occupation requiring more skill or closer attention superadded to the fact that the mechanic never fully acquires a complete mas-

tery of his calling. He is necessarily always a student, a learner, an experimenter, and yet his hours are long and his wages are small. It is partly to be accounted for from the fact that like many other crafts the trade has run into specialists, and workmen are kept at one particular job, and general all-around men are growing scarcer because they are not generally needed.

This is not all. While other trades have been forming unions, at once uplifting and safeguarding the interests of those engaged in the particular craft, the machinists have never succeeded in solidifying their scattered forces, and hence, like a rope of sand, they lack cohesion. The present, however, is full of encouragement. An increase of work in many of the leading machine shops affords the opportunity of making demands and the requests are being granted with a degree of liberality that is very gratifying to all interested in the welfare of skilled artisans.

This in due course will have its reflex action on the condition of the railroad machinist, because the best men will not stay in the employ of the railroads if there are shorter hours and better wages elsewhere, and the railroad officials are quick enough to apprehend the necessity of obtaining and retaining the services of the best skilled men that can be found to maintain the efficiency of the mechanical appliances that are the heart and lungs of railroad transportation.

It has been frequently urged that the legislature is the proper arena of debate in regard to the hours of labor. This is not the case. An eight-hour law was approved of by Congress nearly fifty years ago. Its constitutionality was questioned, with the result that the effect of the legislation was to place a large number of overpaid government employees on short hours, while the common worker was left to make the best bargain that he could. In other words, the law was merely recommendatory, and while it has been occasionally tinkered up here and there and made a little stronger in certain places it is still merely an emasculated regulation benefiting political partisans, if it may be called a benefit to be overpaid and underworked. There is little hope at present from legislatures in regard to reducing the hours of labor, first because the average legislator does not know what too long a day of honest toil means, and secondly because the average working man has seldom sense enough to send one of his own fellow workmen to legislate for him. That there are a few well meaning legislators here and there is undeniable. Senator Cummins, for example, declared in the United States Senate that "excessive hours of labor must cease if we would maintain our standard of citizenship, and the workingman must know that the law is his friend and [illegible], not his enemy and despoiler."

The Injector.

In the early days of railways the boilers of the locomotives were supplied with water by means of force-pumps worked by hand-levers; afterwards the pumps were worked by either eccentrics, or rods attached to the cross-heads, and on the London and South-Western Railway an independent donkey pump was employed to feed the boiler, and at the present time some of the Brighton Company's engines are fed with water by means of a water pump, working in connection with the Westinghouse air-brake pump.

Many of the "locomotive" readers will remember the time very well when engines had two pumps, and in order to supply water to the boiler it was necessary to run several times backwards and forwards for about a quarter of a mile to fill up the boiler.

They will also, no doubt, well remember seeing "single" wheeled engines standing in the sheds, with their tender brakes hard on, slipping upon oiled rails, in order to pump water into the boiler.

In 1858, Mr. H. J. Giffard, a French engineer, took out a patent for the "Injector"; he had discovered that the motion imparted by a jet of steam to a surrounding column of water was sufficient to force it into the boiler from which the steam was taken, and even into another boiler having a higher pressure.

When Mr. Giffard tried to introduce his new injector, locomotive engineers laughed at him, he was told to [illegible] about the first laws of motion, and that he must be mad to suppose that steam from one part of a boiler could force its way back into another part of the same boiler, he could not even obtain authority to try an injector on a locomotive till 1859, and then he was only granted permission as a favor and with a view to "let him prove his idea would not work," and thus put a stop to his constant letters and applications.

However, the injector worked successfully, and the water entered the boiler, but even then people would not believe it.

Mr. Giffard explained that the action of his injector was similar to that of the blast-pipe in a locomotive; the rush of steam in that case formed a partial vacuum into which air was forced by the atmospheric pressure of about 15 lbs. per square inch.

To explain his theory, Giffard took a pressure of 100 lbs. per square inch and showed that a column of water 2.310 feet high pressed upon its base with a force of 1 lb. per square inch, therefore 100 lbs. pressure is equal to a pipe of water 231 feet high.

Water from the bottom of a pipe 231 feet high would rush out at a speed of 121½ feet per second, that is equal to no less a pace than 83 miles an hour.

Let it be clearly understood that a boiler having a pressure of 100 lbs. per square inch is just balanced by a jet of water rushing at 83 miles an hour; it then becomes certain that to overcome the steam in the boiler it is only necessary to increase the speed of the water to above 83 miles an hour, and the water will force itself into the boiler.

The scientific tests that demonstrated that an injector would force water into a boiler did not by any means end the controversy concerning the utility and efficiency of the injector. For years after it was first introduced many of the enginemen considered it a mysterious apparatus whose source of action no one understood. Many years ago, when the writer was engaged on nightwork in an engine house in Scotland he found two enginemen doing some mysterious work on an engine housed in the place. It was from that they took the injector apart, thinking that they could find some secret appliance that made the apparatus work, and they were very much disappointed and disgusted to find nothing but a tube inside. Still for years there continued to be a strong opposition to injectors among enginemen.

In this country the engineers on many railroads insisted that every locomotive they ran should have at least one water pump. In the cold regions during the winter much difficulty was experienced in keeping the pump pipes from freezing, but still the enginemen would insist on pumps being provided. On one day five engines came to the headquarters when the writer was in charge, with pumps and pipes fractured with the frost, and all the injectors were intact. Pumps were then discarded in spite of violent protest, and no more pumps were applied on that railroad.

A New Idea.

A division superintendent of the Pennsylvania has conceived a new idea. Instead of advertising each month what rules had been broken and how many employees had been suspended for little infractions of microscopic regulations, he has reversed the process and is now advertising the name of every man whose service has been more than usually meritorious. The name of this superintendent is A. Keiser, and his experiment has been tried on the Conemaugh division of the Pennsylvania railroad, with the result that in a few months there has been a decrease of cases requiring discipline of 62 per cent. In the matter of suspensions there has been a decrease of 71 per cent, and in the consequent loss of wages through enforced suspensions there

[illegible] 72 per cent.

[illegible] Mr. Keiser, but [illegible] in the same age with him. If all of the railroad men who are in positions of authority could have the heart to take a leaf from Mr. [illegible] of joy would roll over the railroad world, and what blessings would fall upon their official heads instead of the muttered curses that come, not loud but deep, from the aggravated spirits of weary workers whose hands [illegible] and whose [illegible] feet may wander [illegible] little from the hard and thorny path of perpetual drudgery. We frequently hear the names of men mentioned who were said to have started the Safety First movement. All honor to them whoever they were. As far as we are aware, Mr. Keiser is without a competitor. He stands alone. But the royal road that he has traveled is open to every one in authority. Indeed the gospel that he preaches might well be imitated in other departments of human endeavor. The press itself, that mighty trumpet of human achievement, is loud in proclaiming the record of misdeeds, and almost mute in reflecting the brighter and better side of everyday human experience. This could be improved upon, and [illegible] brighter and better, [illegible] each new day instead of looking into a sewer, as it were, where all the things of evil were floating in a foul panorama before the mind's eye, a garden of deeds well done blos- [illegible] good [illegible] the evil, would undoubtedly have its reflex [illegible] itself [illegible]

Boilers—Their Strength and Weakness.

[illegible] boiler which has been worked for years [illegible] first gets a boiler into his premises he [illegible] steam blow off lest the noise means a [illegible] him over that feeling, and then it breeds the contempt which ignorance [illegible] states are painfully in want of laws to regulate the construction, control and regulation of steam boilers, and public [illegible] that leads to the necessary law-making, although the examples of killed and wounded from boiler explosions are [illegible] with feelings of humanity to demand a remedy.

[illegible] tion of all boiler explosions by expert inspectors, and the publication of the facts, would do a great deal to prepare the way for effectual remedies. It is not necessary that expert inspectors are men who must be brought from outside the works where a boiler is stationed or is cleaned. A boiler maker employed by a firm on other work may acceptably act as an inspector when boilers have to be examined. The Railroad Commissioners of the State of Massachusetts, who are noted for the conscientious way they perform their duties, recommended some years ago the enactment of a law, requiring all locomotive boilers to be periodically inspected and tested. Most of the railroad companies considered this law a hardship at first, but most of them now recognize that it was a blessing in disguise. The boilers are inspected regularly at trifling expense and defects of a dangerous character are frequently discovered The mechanical head of one of the railroads in Massachusetts made the public statement after the inspection law was in force for some time, that he would rather quit the road than return to the loose practices that prevailed before rigid and systematic inspection became imperative. If the system [illegible] in Massachusetts were practiced in all states of the Union there would be fewer explosions of locomotive and other boilers.

There are many people who still cling to the belief that there is some kind of mysterious force at work that causes boilers to explode. This belief [illegible] especially [illegible] and have ignorant and unskilled men in charge It is their interest to make believe that accidents to boilers are [illegible]

Two well-known facts give strong testimony in favor of the value of inspection [illegible] boilers, owing to its awkward shape, is the Scotch marine boiler; one of the strongest forms of boiler naturally is the locomotive. Although the Scotch boiler is [illegible] steamers carrying high pressures, no boiler of that type, inspected under the rules of the British Government, has ever exploded. The boiler that explodes [illegible] is the portable locomotive boiler, used with threshing machines. Inspectors now disturb the comfort of the owners of the latter boilers.

Boilers explode only when the pressure of the steam inside is too great for the strength of the material holding the pressure, just the same as an elevator [illegible] heavy for the strength of the cable [illegible] of a cable or a chain used in lifting may be strong enough to raise four or five times the weight successfully, but there happens to be one weak spot which gives way, and disaster follows. The same is the case with boilers. A boiler is not safe unless it has strength to bear four or five times the amount of working pressure. This is called the "factor" of safety. If any spot of a boiler is weak, that spot is the measure of safety of a boiler, for if it causes a sudden rupture, the effect is as bad as if the whole boiler was weak. The weak spots in locomotive boilers are generally broken stay-bolts or corroded sheets. Systematic regular and thorough inspection is the only means of preventing this weak spot from becoming a source of danger. If you take a piece of wire and keep bending it to and fro it will soon break. Certain stay-bolts of a locomotive firebox are constantly subjected to a bending action, and it is only a matter of repeating the bending often enough till the bolt breaks. The means of detecting breakage ought always to be as active as the agencies at work to cause accident.

Government Cheating Railroads.

Certain politicians for years made profitable capital out of abusing railroad interests and they worked up their property of abuse so industriously that public sentiment was swayed to their side and many honest people have come to believe that no railroad interest is worthy of respect. The working up of that sentiment is demoralizing to the American people. It is working up a belief that dishonesty is no crime. It is a melancholy fact that officials connected with the United States Postoffice systematically cheat the railroad companies and seldom any protest is made by the American public. Representatives of public opinion sometimes direct attention to the form of stealing referred to, but the iniquity goes on. In a striking letter, published by the New York *Globe*, Robert P. Green states some striking facts when he says:

"Providence does not always require perfect men to act in attaining great results or pushing great reforms. For example, the postoffice is a great institution and the parcel post the greatest and finest gem of it all, yet imperfect men carry it on. Think of the government bullying the Pennsylvania Railroad into carrying as mail some ninety-nine million dollars in gold, paying little or nothing for the service, and requiring guards and safety devices commensurate with the value of this new style 'mail'!

"Think of the Postoffice Department selling stamps for parcel post packages according to weight and yet contending [illegible] payment to the railroads so

that the latter may carry one ton or twenty for the same payment.

"Think of the general imposition and bulldozing by the postoffice on the railroads when parcel post matter in general is carried as mail without payment for over 50 per cent. of the stuff carried.

"Our ancestors resisted writs of assessment and other dishonest and unjust impositions of government some generation since—what cause withholds the railroads from flatly refusing to submit to the robbery? They are putting in claims to the Court of Claims for back pay—why not emphasize it by going on strike against further bleeding? I wish I were a railroad president. I'd do it tomorrow. Nothing whatever would be done to me, either. The robbery would stop next day."

Power of Education.

Our attention has been directed to an article in one of our leading dailies giving results of a canvass of positions held by college graduates and the salaries one hundred of them are earning after being ten years in active service. The college mentioned is a New England institution largely devoted to engineering instruction. The statement is made that the graduates are receiving incomes averaging over two thousand dollars annually; that one of them earns six times that amount and eleven others earn from $4,000 to $7,000 each. It was long since disclosed that the college graduate had a better prospect of getting his name into "Who's Who" than the man without a degree, and now it seems that he has what will count much more heavily with many persons, namely, the likelihood of a larger income than that of those to whom Sophocles is not even a faded memory.

These facts are highly creditable to the advantages of a college training, but our experience among men who have risen to important positions indicates that the apprentice who studies the science of his business rises quite as rapidly as the college graduate. The apprentice schools that have now been established connected with many railroad repair shops are training up men who are destined to become the leaders in the mechanical world, and many of them are already making rapid steps upward.

Knowledge is power is a fact illustrated in all lines of endeavor. People who appreciate this are most likely to possess the power that raises them above the dull, indifferent person. Since the above lines were written a visitor who rose from the ranks to be superintendent of motive power, remarked, "The ladder that helped me up was RAILWAY AND LOCOMOTIVE ENGINEERING. That was the educational power.

Ignorant Legislation.

It has been our privilege to listen to the deliberations of a great many organizations that discuss various questions supposed to excite difference of opinion. Our first introduction to such mental efforts was in debating societies where young men expressed themselves as being ready to guide the destinies of mankind. Then came meetings of labor organizations where mental modesty was not conspicuous. Then we came in contact with parliament, congress and state legislatures. For the display of ignorance and crude ideas state legislatures are conspicuous for ignorance and want of common sense.

In this respect the State Legislature of North Carolina shows above all others. One section of law enacted by that assembly refers to the appointment of a fireman for the Supreme Court building, and reads as follows: "That the fireman of the Supreme Court building shall be appointed by the chief justice and associate justices of the Supreme Court, and when not engaged in his duties as fireman shall act as assistant janitor of the Supreme Court, and shall assist in the cleaning and care of the Supreme Court, and perform such other duties as may be designated by the said justices of the Supreme Court."

It would be interesting to know how many of the learned lawmakers who approved of that law ever saw a fireman at work, or how many of the justices of the Supreme Court feel themselves competent to pass on the qualifications for a fireman. By placing the boilers of the building immediately under the august body that appoints the fireman, something might happen some day to impress upon the justices, or such of them as might be left, the reasonableness of allowing the fireman to be selected by some one who knows at least a little about boilers, and what it means to operate them efficiently and in safety.

The Solar Engine.

An American [illegible] ago that even on so small an area as Manhattan Island, the noon-tide heat is sufficient, could it be utilized, to turn all the steam engines in the world. Can it not be utilized? If a little lens can focus enough sunshine to blister one's hand, and if big mirrors, as the Roman historians tell us, were used to set the enemy's fleet afire, may we not expect that some day a gifted inventor will contrive an instrument for gathering and storing and distributing the heat energy of the sun? Engineers are now working at this problem with encouraging results. Stationary engines have been run by means of huge reflectors, and other experiments, rich in suggestion, have been performed. The time will come, Ericson predicted, when Europe must stop her mills for lack of coal, unless a substitute fuel is found. "Then," he added, "upper Egypt, with its never-ceasing sun-power, will invite the manufacturer to remove his machinery and erect his mills on the firm ground along the sides of the alluvial plain of the Nile, where an amount of motive power many times greater than that now employed by all manufactories of Europe may be obtained." If the future achievements of science and invention are in wise proportionate to those of the past—and who can doubt that they will be incomparably greater?—the solar engine is but one of a thousand marvels in store.

Enormously Expensive Government Railroad Construction.

We are indebted to Mr. W. G. [illegible], president of the Central Railroad of New Jersey, for directing our attention to a case of government railroad building which is doubtless representative of what railroads would cost if the construction was taken away from private enterprise and conducted by the people's representatives.

The National Transcontinental Railway of Canada was prospected to extend 1,803 miles and the Canadian Government undertook the work of construction under representation that it would be done at much less cost than by private construction. The estimated cost was $61,000,000. The project was pushed ahead and by December 31, 1914, it aggregated the enormous sum of $173,000,000. It will still require several millions more to equip the property, before it may be operated.

There seems to be a growing sentiment in the United States toward Government ownership of railroads, and in this article there is set forth the actual experience as to what transpires in the case of government built railroads, and shows the extravagant and wasteful methods employed by a Government Commission which had no knowledge of or experience in the matter of railway building.

Of course, the taxpayers of Canada will have to foot the bill, and make good the deficit, the same as would be the case in this country, under Government ownership.

Everything is good which takes away one plaything and delusion more, and [illegible]

The love which believeth all things, is one of the glorious attributes of youth; but the love which endureth all things, is a later and a finer growth.

Locomotive Running Repairs

By JAMES KENNEDY

I—Introductory and Division of Engine House Work

[illegible] repairs [illegible] to which something new are constantly being added. The modern locomotive is not only much larger than that of the last century, but also much more complex, and hence it is necessary for railway men to keep in touch with the growing requirements of the time. The best methods of doing repairing work on locomotives twenty or thirty years ago would now be, in many cases, impracticable. Many new appliances for the repairing of locomotives have come into being of recent years, with the result that such work is now completed within a space of time so limited that it would formerly have seemed incredible. The improvements in traveling and jib cranes, the introduction of electric and compressed air motors, the endless variety of new machines, together with the remarkable degree of perfection to which almost every kind of tool has been brought, not to speak of the greater purity of metals, especially in the finer grades of steel, have almost revolutionized the art of making general and running repairs to locomotives.

It will readily occur to all engaged in railroad work that in the vast realm of mechanical ingenuity, as exemplified in meeting emergencies, it would be impossible to lay down specific rules for every contingency that may arise. Much [illegible] will continue to happen that cannot be [illegible] seem to be the best method of meeting an emergency or repairing a breakage is not readily applicable to every condition. Different methods may be applied to meet [illegible] servable among the most skilled mechanics that individual artisans have varieties [illegible] liarly their own.

The same remark applies in a larger sense to machine shop tools and methods. In the New England States there is a degree of fineness to be observed in the smaller class of tools that is not equalled in any other part of the country. This is especially the case in the [illegible] the processes of milling and grinding. In the central or main arterial lines of rail- [illegible] siveness in construction in the larger kinds of tools, whereby the most ponderous parts of the mechanical appli- [illegible] place to place with great ease and quickness.

Modern roundhouses, or engine houses, as they are more properly called, because they are not all round, are keeping pace in the matter of equipment with the machine shops. The older of the establishments are of a kind that make running repairs difficult of accomplishment. This is especially the case where the largest kind of locomotives are housed in limited quarters, and it is gratifying to observe that the construction of new engine houses is going on with increasing rapidity. The Western railways are being particularly well equipped in regard to engine houses. These new buildings are fitted up more like machine shops, as they should be, and the engine house machinist bids fair to be as conveniently served and as comfortably housed as those whose work is carried on in the best machine shops. Generally speaking the engine house machinist of our time is better provided for in personal comfort and appliances than many who are engaged in the older machine shops.

DIVISION OF ENGINE HOUSE WORK.

Coming to the matter of general and running repairs, the work formerly divided itself into two classes, running and general repairs. The running repairs were such as were naturally arising from the incident of daily [illegible] sufficiently important in themselves to call for a systematic repairing of all or any considerable number of the wearing parts of a locomotive. General repairs on the other hand, were properly said to consist of the complete repairing of all of the wearing parts of the locomotive after a lengthened period of service. Most of the chief railroads measured this period of service by the number of miles run. If the service performed by the locomotive is regular and the running repairs properly attended to, it is a safe method to establish a mileage record, as a maximum distance which a locomotive may run between the general overhaulings.

This simple division, however, is becoming more complex, and in many of the leading locomotive shops we now find four or five diverse classifications of repairs which may be briefly enumerated in their degrees of importance, the first division embracing such locomotives whose prolonged service requires that a [illegible] refers to such organic changes as the application of superheating appliances embracing, as it does, considerable structural changes in the steaming apparatus; the third refers to such locomotives as require that all flues should be renewed, and that all the wearing parts of the engine should be repaired or refitted as may be found necessary; the fourth class consists of such repairs as may accidentally arise and are not to be specifically classed with the fifth or last division, which are the light or running repairs constantly calling for attention in the vicissitudes of daily service.

A fair average mileage run by a locomotive between the period of complete repairing was set at about 100,000 miles many years ago. This distance is being lengthened as improvements in material and mechanism continue. Twelve or fourteen years' constant service was also set as the length of time in which not only the best kinds of boilers would be worn out, but also all of the other parts of a locomotive that are subject to the severe stresses incident to locomotive service. Yet in spite of these facts it is no uncommon sight to see locomotives that have passed twenty years of hard service still doing work of a kind that may be of value in the requirements of the local conditions that exist where the locomotive is located. Generally speaking there is a doubtful economy in this, for even with the reduced pressure, the constant call for repairs, the liability to fracture, the waste of fuel, and the need of a more than common skilled attention all call for a retirement even if their yoke is easy and their burden is light.

(To be continued.)

Handling Men.

You can't do the biggest things in this world unless you can handle men; and you can't handle men if you're not in sympathy with them; and sympathy begins in humility. I don't mean the humility that crawls for a nickel in the street and cringes for a thousand in the office; but the humility that a man finds when he goes gunning in the woods for the truth about himself. It's the sort of humility that makes a fellow proud of a chance to work in the world, and want to be a square merchant, or a good doctor, or an honest lawyer, before he's a rich one. It makes him understand that while life is full of opportunities for him, it's full of responsibilities toward the other fellow, too.

Air Brake Department

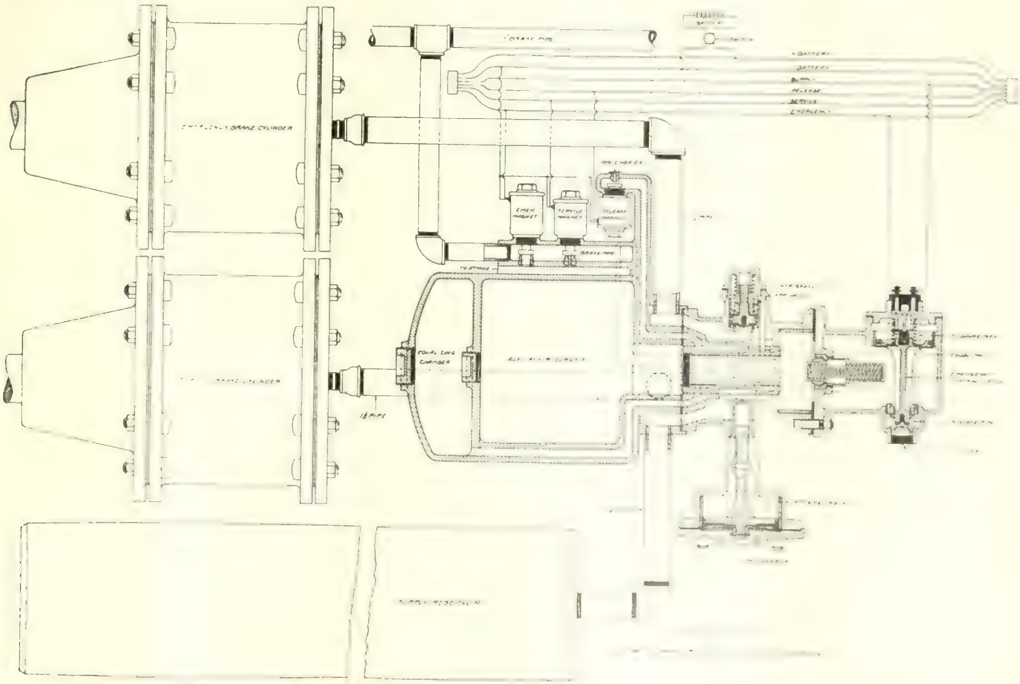
Pittsburgh Air Brake Company's Electro-Pneumatic Brake For Passenger Car Equipment.

In the June issue, it was stated that the Pittsburgh Air Brake Company has developed an electro-pneumatic brake for steam road-passenger service, and that a description of it would be given our readers at the earliest possible time. We now present several views that will serve to indicate the general arrangement of the brake system. The large cut shows a two-cylinder arrangement, one brake cylinder for service operation and both for emergency.

The operating valve is termed a control valve and governs the flow of compressed air to and from the brake cylinders, and is actuated by variations of pressure in the brake pipe. An electro-pneumatic brake will be understood as one in which compressed air is utilized to develop a force in a brake cylinder which is transmitted through a foundation brake gear to bring the brake shoes in contact with the wheels, the electric current being used for the purpose of obtaining simultaneous and uniform action from the operating valves to the intent that all brakes in a train may start to apply and start to release at the same instant, and that the full application of brakes may be practically instantaneous when desired.

This brake has been designed and developed to comply with the following essentials:

1. Interchangeability.
2. Simplicity of construction.
3. Flexibility in manipulation.
4. Instantaneous and simultaneous brake application at any time.
5. Sensitive and positive release at any desired rate.
6. Graduated release.
7. Automatic charging control to prevent the possibility of "stuck" brakes.



8. Continuous compensation for over-reduction in brake pipe pressure.
9. Instant high emergency braking power at any time before or after service application.
10. Maximum practicable difference between service and emergency braking power.
11. Prompt and positive release not impaired, following an emergency application, regardless of high brake cylinder pressure.
12. Elimination of undesired quick action.

These [illegible]

ficiency of service and economy of maintenance. Each of the several portions of the valve constitutes an independent unit; and the fewness of the combined parts, which make up the complete valve, and their accessibility, make it easy to clean and to repair.

It is designed to operate any number or size of brake cylinders combined as follows:

(a) One brake cylinder in service, attaining the maximum braking power in same cylinder at time of emergency.

(b) One brake cylinder in service with [illegible] taining the maximum braking power in the same cylinders at the time of emer[illegible]

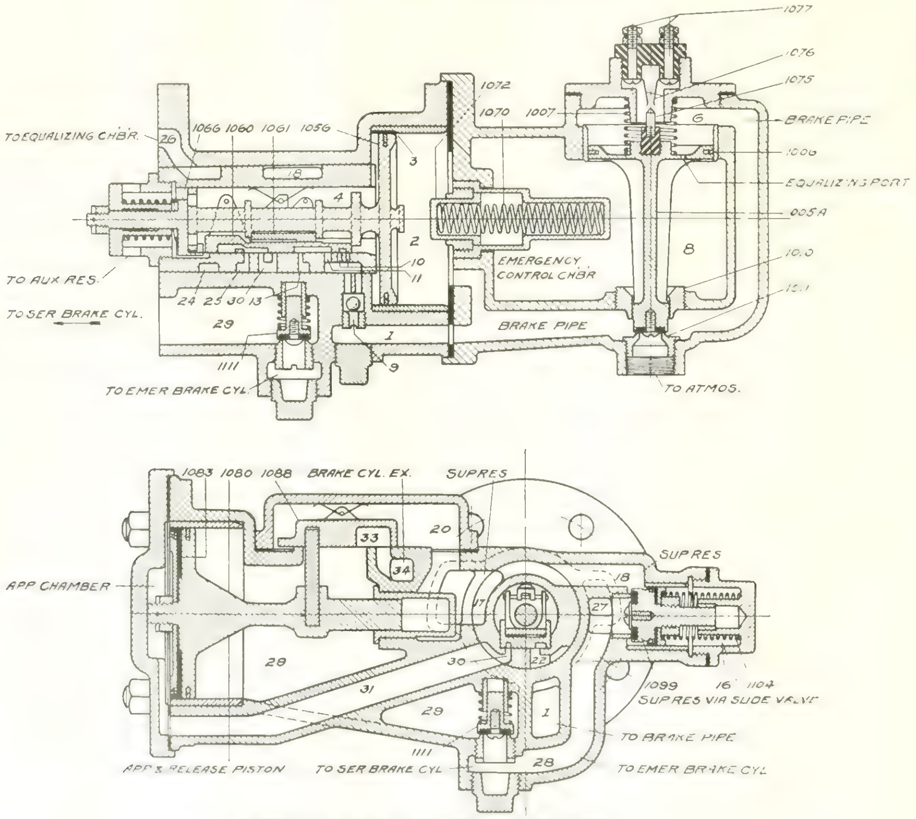
(c) Two brake cylinders in service with an additional one in emergency.

In each of the above conditions, an even braking power is obtained and maintained according to the brake pipe reduction, regardless of unequal brake cylinder piston travel, brake cylinder leakage, or size of the cylinder.

It is important to note that the valve is of the pipeless type, is connected to the

[illegible] four bolts, and [illegible] pounds; for [illegible] can easily replace a defective valve at any repair point or divisional terminal while engines are being changed, necessarily resulting in a profitable saving of time. In fact, the car never has to be put into the shop on account of any defect in the air brake valvular mechanism.

From previous descriptions of electro-pneumatic brakes, our readers will understand that the electric and pneumatic features control an exhaust of pressure as desired. The difference between electric and pneumatic operation is that when a service application is desired, the service magnets are energized by contacts made at the engineer's brake valve and a local, simultaneous brake pipe reduction is made at each of the magnet valves before the engineer's brake valve has had time to discharge brake pipe pressure. The difference between service and emergency lies in the difference in rate of brake pipe reduction as made by the magnet valves—desired degree of braking force or braking effect is obtained, the brake valve is moved to release and holding positions, as may be required, and when release is desired, a movement to running position de-energizes the release magnets, and all brakes start to release at the same instant, and the release may be graduated by alternating the valve handle between running and holding positions. There is also an emergency switch connection operating an emergency control piston, such as the "No-Kicker" device for the triple valves.



NORMAL CHARGING AND RELEASE POSITION

DIAGRAMMATIC VIEW OF CONTROL VALVE

[illegible] the same positions of the brake valve are used whether the brake is operated electrically or pneumatically. Hence, if electric current should fail, the pneumatic operation of the brake will not be affected.

Electric current is transmitted through battery and supply wires and separate wiring lines to magnets known as service, emergency and release magnets, which makes it possible to instantly energize or de-energize such magnets, and these in turn seat and unseat magnet valves which [illegible] suitable [illegible] rate of brake pipe reduction, and the emergency magnet valve having an opening sufficiently large to produce quick action. The difference between electric and pneumatic release is that in release or holding positions of the brake valve, the release magnet is energized and the magnet valve traps the equalizing and application chamber pressures, which in turn holds the brake cylinder application and release piston and slide valve in lap position; thus after the which transmits instantaneous quick action throughout the train in the event of the bursting of an air hose, a ruptured brake pipe or by opening the conductor's valve.

One of the details of mechanical design and construction of this valve which distinguishes it and is deemed worthy of mention, is found in the fact that the main slide valve makes the full travel of its seat upon each application of the brake, whether in service or in emergency. This prevents uneven wear of the valve seat.

with the resultant advantage that in an emergency application, which occurs so rarely in comparison with service applications, the slide valve is not made to traverse any new and unevenly worn surface, which might cause the brakes to leak off by reason of the broken and imperfect contact between the face of the slide valve and its seat.

The operation of the control valve or operating valve of this brake system and the flow of compressed air in general, is the same for either pneumatic or electric brake pipe reductions. Therefore, in order, to explain the movements of the control valve portions, it will not be necessary to refer to the magnet valves or electric current. From the diagrammatic views, it will be observed that the control valve is bolted to a two compartment reservoir, one portion known as the auxiliary reservoir, the other as the equalizing chamber. When compressed air is admitted to the brake pipe, it charges the emergency control chamber, the auxiliary reservoir and the supply reservoir, to the pressure admitted to, or carried in, the brake pipe, while the equalizing and application chambers and the brake cylinders are open to the atmosphere.

The construction and operation of the apparatus is such that the compressed air admitted to the reservoirs from the brake pipe is trapped, so that a reduction in brake pipe pressure results in the auxiliary pressure becoming the higher and forcing the equalizing piston and its attached slide valves to a position where suitable connections are made between the auxiliary reservoir and the equalizing chamber and application chamber, so that the auxiliary reservoir pressure lowers by expansion to correspond with the lowering of brake pipe pressure and gives a proportionate rise of pressure in the equalizing and application chambers.

The sizes of reservoirs are such that the auxiliary equalizes with the two chambers mentioned at 87 lbs. pressure per square inch from an original auxiliary pressure of 110 lbs.

When the auxiliary pressure enters the equalizing and application chambers, the application p[illegible] to a position where an attached slide valve closes the service brake cylinder exhaust port and admits air from the supply resorvoir to the service brake cylinder. Upon a cessation of brake pipe reduction anywhere short of the equalizing point, the resultant change in the balance of pressure permits brake pipe pressure to move the equalizing parts to lap position which cuts off the flow of air to the equalizing and application chambers, and the latter pressure then becomes, and remains, stationary; and when the brake cylinder receives a similar pressure from the supply reservoir, the application portion is moved to lap position. A further reduction in brake pipe pressure causes the valves to repeat the operation, but any leakage from the brake cylinders will be supplied from the supply reservoir as leakage from the cylinders will destroy the balance on the application piston and the application chamber pressure remaining constant will force the application portion to application position and promptly raise the brake cylinder pressure to the same figure as that in the application cylinder.

During the time of a brake pipe reduction, a quick service port is opened by the movement of the equalizing slide valve which serially hastens the reduction throughout the train. This well known feature requires no particular explanation. Provision is also made for an expansion of auxiliary reservoir pressure to the atmosphere in the event of an over-reduction of brake pipe pressure, thus at all times maintaining a perfect equilibrium of pressure on the auxiliary and brake pipe side of the triple piston which insures prompt and positive release and eliminates undesired emergency due to accidental over-reduction of brake pipe pressure and the pressure in the emergency control chamber is free to escape without any chance of producing undesired quick action.

If, however, a sudden and heavy reduction in brake pipe pressure is made, or whenever the required rate of emergency reduction is obtained, the control chamber pressure cannot reduce at a rate corresponding with the brake pipe reduction and the emergency control piston is unseated and the brake pipe opened to the atmosphere for the propagation of quick action.

As a result of the rapid drop of brake pipe pressure the equalizing piston and slide valve are forced to the full travel of their stroke, compressing the graduating spring and in this position, the auxiliary reservoir and equalizing chamber promptly equalize, while the supply reservoir pressure is permitted to equalize with the application chamber, instantly opening the supply reservoir to the service brake cylinder, and at the same time the pressure is exhausted [illegible] emergency brake cylinder application valve, which permits the supply reservoir pressure to also open this valve and equalize with the emergency brake cylinder. In this manner, the auxiliary reservoir and the equalizing chamber remain at 87 lbs. pressure, and the brake cylinder pressure developed depends upon the size of the supply reservoir, the volume of which may be such as to give 105 lbs. or more, brake cylinder pressure.

Thus the release of brakes is accomplished by restoring the brake pipe pressure to a figure a trifle higher than that of the auxiliary reservoir, 87 lbs., which forces the equalizing valve to release and charging position, though the brake cylinder pressure may be 105 lbs. or more. The service cylinder pressure then escapes as previously explained and the emergency brake cylinder pressure opens check valve 1111 and escapes with the service cylinder pressure.

The control valve also embodies a restricted recharge in which a retarding device permits of an extended travel of the equalizing valve for a restricted recharge of the supply reservoir and a quick recharge of the auxiliary reservoir which is intended to prevent a rapid absorption of brake pipe pressure at the head end of a train during release, and to permit the initial high pressure wave to promptly release the brakes on the rear end, and also, to provide means for a prompt re-application, following release, when desired.

Alterations may be made whereby the ordinary rate of application or time of release may be lengthened if considered advisable, but such details are arranged to meet the requirements of the purchaser of the apparatus.

In a future number, we will arrange a description of the locomotive brake furnished by the Pittsburgh Air Brake Company.

From Locomotives to Shells.

The period of industrial depression that the country has been passing through has been particularly hard on those engaged in the construction of railroad machinery, and not a few of the locomotive and car building works have been closed down. The Dunkirk Locomotive Works has been one of the greatest sufferers from the industrial depression, but now the establishment is meeting with new activity in the manufacture of shrapnel shells. We should be much better pleased to learn that these fine shops had become active organs in the construction of locomotives, for which they were long famous, but any port in a storm, say we, and we are gratified to find the workmen earning a good livelihood even in the construction of missiles that may be employed in war.

The Mesta Machine Company, Pittsburgh, Pa., has recently shipped a 1,500-ton quick acting steam-hydraulic forging press to the Pressed Steel Car Company. This press is of the Mesta standard four-column type and is to be used for heavy forging work. Among the important features of this press are the valves which permit the use of a single controlling lever and cause the press to automatically stop at any point the operator desires. With this valve, the press cannot jump which makes it of extreme value in punching, shearing, etc. The intensifier is located directly above the hydraulic cylinder, thus eliminating the necessity of high pressure

New Switching 0-8-0 Type of Locomotive for the Lehigh and New England Railroad

Application of a Drifting Throttle to Main Throttle Valve

[illegible] Works has recently completed, for the Lehigh and New England R. R., two switching locomotives [illegible] type which embody several interesting features in their construction. This type is being used to a limited extent for heavy service. In the present instance, the tractive force exerted is 46,000 pounds, and with a ratio of adhesion of approximately 4.5 these locomotives should be able to handle heavy loads without slipping, even with unfavorable rail conditions.

The fuel used is a mixture of bituminous coal and buckwheat anthracite, and this is burned in a firebox of the modified Wootten type without a combustion chamber. The grate bars can be shaken independently of each other; they run longitudinally and have trans- [illegible] The [illegible] are welded [illegible] in the water legs. The dome contains [illegible] which has recently been applied by the builders to a number of locomotives. The vertical throttle pipe is flattened [illegible] pipe close to the wall of the dome, the clearance is sufficient to permit a man to enter the boiler. Another special feature is a drifting throttle which is [illegible] valve. The drifting throttle is raised by the throttle lever, and it has a lift of [illegible] inch before the main valve begins [illegible] necessity for applying by pass and va- [illegible]ted on the locomotives now under consideration.

These locomotives are fitted with Schmidt type superheaters having 26 elements, and the steam is distributed by 14-inch piston valves. The valve motion is of the Walschaerts type. The equalization system divides between the second and third pairs of driving-wheels, and the engine is cross-equalized at the forward end. Flanged tires are used on all the wheels, and the equipment includes flange lubricators on the front and rear drivers. The engines are used on curves of 20 degrees.

The principal dimensions are as follows:

Gauge, 4 ft. 8½ in.; cylinders, 22 ins. by 28 ins.; valves, piston, 14 in. diam.

Boiler—Type, Wootten, straight; diameter, 74 in.; thickness of sheets, [illegible] 13/16 in.; working pressure, 200 lbs.; fuel, soft coal [illegible] radial.

Firebox—Material, steel; length, 126⅛ in.; width, 108¼ in.; depth, front, 62 in.; depth, back, 55 in.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space—Front, 5 in.; sides, 4½ in.; back, 4½ in.

Tubes—Material, [illegible] in. and 2 in.; thickness, 5½ in. [illegible] W. G.; thickness, 2 in., No. 12 W. G.; number, 5½ in., 26, 2 in., 177; length, 14 ft. 4 in.

Heating Surface—Firebox, 220 sq. ft.; tubes, 1,854 sq. ft.; total, 2,074 sq. ft.; grate area, 95 sq. ft.

Driving Wheels—Diameter, outside, 50 in.; diameter, center, 44 in.; journals, 10 in. by 12 in.

Wheel Base—Driving, 14 ft. 3 in.; rigid, 14 ft. 3 in.; total engine, 14 ft. 3 in.; total engine and tender, 49 ft. 8 in.

Weight—On driving wheels, 207,850 lbs.; total engine, 207,850 lbs.; total engine and tender, about 360,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 in.; journals, 5½ in. by 10 in.; tank capacity, 8,000 gals.; fuel, capacity, 14 tons; service, switching.

Locomotive equipped with Schmidt superheater.

Superheating surface, 443 sq. ft.

[illegible] LOCOMOTIVE FOR THE LEHIGH [illegible] RAILROAD

[illegible] Works [illegible]

Locomotive Fuel Bill.

According to Mr. Robinson, the fuel bill of the railroads of the United States for the 65,000 locomotives now in use aggregates the enormous sum of $250,000,000 to $275,000,000 per annum and now represents about twenty-five per cent. of the total transportation account expenses. He estimates the use of powdered coal will result in savings on various heat losses alone of twenty-five per cent., though actual performance to date in exhaustive tests shows as high as thirty to forty per cent. savings. This does not include savings from the elimination of smoke, soot, cinders and sparks, ash handling, the use of inferior grades of soft coal, elimination of smoke inspectors, which, in the city of Chicago alone, costs the railroads $65,000 per annum, and the elimination of many other problems that enter into the production of steam power in locomotives.

Heat, Motion and Work, Their Units of Measurement

The Blessing of the Steam Engine

It is hardly necessary to state that the modern steam engine is a machine in such common use that it fails to excite attention. We do indeed give passing notice to something out of the usual order, as when engines of unusual power are placed on a railroad, a steamship or elsewhere; but how few of us ever stop to think how much that enters into our daily lives is due to the genius of the men who have saddled and bridled steam for the everyday use of humanity. For the civilization we enjoy, we are indebted to the steam engine more than to any other agency; more than to all other agencies. Without it the civilization of the present day—or anything approaching it—would be impossible. It pulls the trains, spins the thread, and weaves the cloth we wear; it fashions the furniture we use, and weaves the carpets we walk on; it annihilates distance, and places in our hands the products of the most remote countries; it carries us to and from the scenes of our daily labor, and though most of us cannot own a carriage, the steam engine enables us to travel with a convenience never dreamed of before its common use, and at a cost so moderate that the poor may now enjoy what the rich could not enjoy before its advent. It does all of these things and a thousand beside that eclipse the wonders of Aladdin's lamp. Yet so gradually have the blessings of the steam engine been brought to bear upon civilization, so slow and steady has been the advance of steam, that there has been no place for wonder. We do not marvel at the rising and setting of the sun, or at the progression of the seasons, because we have been accustomed to these changes from our infancy. For similar reasons we do not marvel at the changes wrought by steam. Those men who have brought the steam engine to its present state of perfection have done more, a thousand times more, than all the conquering armies of the world, yet how little we know of them. The immediate change from the rigor of winter—from the frozen streams and frosty atmosphere to midsummer, would set every tongue in motion, and yet the change in human affairs, wrought by the advent of the steam [illegible] marvelous.

It is not our purpose to sing praises to the steam engine, or to those who have perfected it. But it is interesting and instructive as well to go back and briefly glance at progress in the use of steam. We see the well-nigh perfect steam engine of today, and if we were to see it today for the first time, reason would teach us that it was not always so nearly perfect. We should naturally know [illegible] the result of persevering labor.

[illegible]

It is impossible to say how many thousand years ago men boiled water and saw the vapor rise and float away in the air. And as some writer has pointed out, they could not have failed to observe that this vapor exercised force in escaping from the water, and making its way into the atmosphere. Here, then, was an essential fact that might lead to the conception of the steam engine. This steam, imperfectly confined, would lift the cover, perhaps a stone, from the vessel containing the water. It would do the work. If it would do this work, it could be made to do useful work. That would be the natural line of reasoning. Why, then, did it require so long a time to put the knowledge of the fact that this vapor from boiling water contained the essence of motion to useful purposes? It was because the utility of knowledge of a fact depends [illegible] upon concurrent knowledge. If some one, two thousand years ago, had conceived the steam engine of today there was no one who could have built it. And it was not conceived because no one could build it. Suppose it had been built, there was no use to put it to. There was no such association of ideas as rendered the conception of the steam engine possible. We can today conceive of many [illegible] fashioned from metals, because we know these metals exist, and because we know there are those skilled in putting them into the desired shape. [illegible] knowledge of how to extract these metals from the ores and to fashion them did not exist then we could not conceive of these things. It would be useless for one man to know much unless there were others who knew a good deal. It may appear at first thought strange, but it is nevertheless true, that every one in this world is interested in helping his neighbor to knowledge. If we get much ahead of the general knowledge of the world we are in the estimation of the world cranks. The world will always be full of cranks and their lot is not a happy one. But we are talking of the steam engine.

HERO'S STEAM ENGINE.

Something like two thousand years ago, Hero, of Alexandria, we are told, made the first steam engine. You have all seen pictures of Hero's engine, so we need not speak of its construction further than to say that it contained the germs of the steam engine of today. It was not very much like a modern steam engine, but it contained within itself what would, we [illegible] besides the steam engine, have speedily become a thing of levers and shafts and other accessories. But in Hero's time there was not in the world the concomitant knowledge to bring this about. This lack of knowledge in others was mainly due to the fact that in his time those who worked did not think. They were not expected—were practically forbidden to think. Between the men who worked and those who thought, or thought they thought, there was as wide a distinction as can well be imagined. And this distinction prevented anything coming of Hero's demonstration of the utility of steam as motive force. Nothing ever came of it until this sharp distinction between working and thinking was broken down; until the philosopher, as a class distinct from the rest of humanity, practically disappeared; until men who looked at the utility of things and who could both plan and execute, began coming to the front of the material affairs of the world. Hero's conception remained a toy until this change in human affairs came about. And but for this change it would still be a toy. You may divide up labor as much as you will, you may assign this part to that one and another part to another one, but you can never succeed if you separate brain from muscle. Without in some degree the ability to plan there will never be the skill to execute; in even a more pronounced degree is it true that, without the skill to execute, the wisdom to plan will be wanting. The world is prosperous today because of this combination, and it is to this combination that the wonderful advancement in the arts and sciences is due. The history of every nation in the world will sustain this proposition. For thousands of years it was sought to work out some other civilization than that based upon a condition of general intelligence, but the effort was a failure.

[illegible]

When the time came that man was conceded the right to work and think in combination, the working mechanic turned his attention to the steam engine. Thomas [illegible] a cylinder in which a piston moved steam- [illegible]

The fact worthy of note is that thus, the [illegible]

[illegible] valuable to [illegible] the younger [illegible] plain to require elaborating. The men of science were [illegible] forge. [illegible] Newcomen's habit of fashioning iron to [illegible] thought in practical direction, instead of on severely scientific lines. The plain blacksmith distanced the ornate philosophers because he knew more things that were useful than they knew. He was wiser than they, if [illegible] wisdom [illegible] what it can accomplish. He was not trained to think as the philosopher thinks. He had trained himself to think in the rugged school of experience, where the best training comes from. One can imagine—almost see—Thomas Newcomen in the glow of his forge thinking out the problem of that cylinder and piston that ought to have made him more famous than he is.

So on, from the time of Newcomen down to the present time the advances towards the science of steam engineering have been made by plain workingmen, men who wrought with their hands and thought with their brains.

[illegible] ENGINEERING.

But you do not care to hear the history of the steam engine and the men who perfected it nor I to repeat that history. It would not be essentially different from the history of a thousand other things that have helped the world along in its progress. The history of all these things brings to the front what, according to common acceptation, are workingmen. Science has played a remarkably small part in the material progress of the world we live in. What we purpose is to say a few words about getting mechanical work from coal, which is something that most [illegible] working hours, and no doubt think a good deal about during hours you are not at work. Because the steam engine occupies the place it does occupy in the world's economy, and because the practical side [illegible] side, this question of getting useful work [illegible]

It seems to the uninitiated a simple matter to shovel coal into the furnace of [illegible] use the resulting steam, but you who do this know that to do it right, to do it so [illegible] very far from being a simple matter. On [illegible] thing to learn [illegible] process of getting mechanical work from [illegible] but a small percentage of the latent energy of coal, as useful work, this is true enough. But while there is a great loss of useful effect in the steam engine and boiler that cannot, in our present knowledge, be avoided, there are other losses that can be materially modified. In order to see how this may be done it is necessary to see what these losses are.

What Our Workers Are Doing.

A Report on Occupations in the United States has just been issued by Director W. J. Harris of the Bureau of the Census, Department of Commerce. It is based of course upon the census of 1910 and shows that at that time there were 38,756,223 persons 10 years of age and over engaged in gainful occupations in the United States, including Alaska, Hawaii, Porto Rico and the military and naval stations abroad. These constituted 41.5 per cent. of the total population.

"Study of the report," says the New [illegible] shows that in the total population of the United States more than two-fifths of all persons, over three-fifths of all the males, but less than one-fifth of all the females, were engaged in gainful occupations in 1910, and in the population [illegible] than half of all persons, more than four-fifths of all the males, but less than one-fourth of all the females, were gainfully occupied. Classified by States, the pro- [illegible] old who were at work ranged from 46.9 [illegible] per cent. in Mississippi. In all but three States (Arizona, Montana and North Dakota) there was an increase from 1900 to 1910 in the part of the population engaged in gainful [illegible]

"In 1910 almost exactly one-third of the workers in the United States were engaged in agriculture, forestry and ani- [illegible] fourth (27.9 per cent.) were engaged in manufacturing and mechanical industries.

"Of a total of 29,073,233 persons in all occupations in the continental United States in 1910 81.7 per cent. were males and 18.3 per cent. females. Detailed figures show that domestic and personal service was the only general division of occupation in which the women outnumbered the men. In professional service four women were employed for every five men, many of the women being teachers. In clerical occupations one-third of those employed were women, in manufacturing and mechanical work one-sixth were women, in agriculture, forestry and animal husbandry one-seventh were women and in trade one-eighth."

Another Side Launching on the Great Lakes.

Side launchings are universal on the great lakes, due to the fact that the ship yards are generally located within the [illegible] large port [illegible] on adjacent rivers and consequently due to the limited space available [illegible] launching is out of the question.

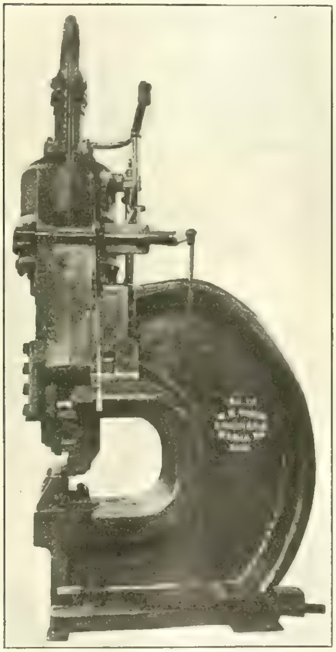
[illegible]

"Plymouth Products" describes the launching of the steel twin-screw car ferry, Ontario No. 2, at the yards of the Polson Iron Works, Limited, Toronto, recently. This ferry is of the shelter deck type, 318 feet long and 54 feet beam, and is built with solid plate floors and extra heavy scantlings. She is equipped with transverse and longitudinal bulkheads and has a gross tonnage of 5,400. Manila ropes 3 inches and 5 inches in diameter were used for launching triggers and mooring lines.

This vessel will have a capacity of thirty loaded cars and a thousand passengers and will connect the Grand Trunk and Buffalo, Rochester and Pittsburgh railroads between Cobourg, Ontario, and Charlotte, New York.

Heavy Hydraulic Shear for the United States Government

The accompanying illustrations show front and side views of Wm H. Wood's shear, as built for the United States Government, for shearing heavy vanadium steel plates 1½-inch in thickness. The shear is designed with a 26-inch throat and has a capacity of 200 tons to shear the plates when working from a hydraulic accumulator pressure of 1,500 pounds to the square inch. It will be noticed from the illustrations that the shear blades are reversible and the shear is prepared for use so that the shear blades can be removed and substituted with attachments, with punches and dies for punching heavy



SIDE VIEW WOOD'S HYDRAULIC SHEAR

plates. It is well to state that nearly the whole of the machine is made from cast steel on account of the heavy pressure which is required for shearing the plates, the rams being made of air furnace cast iron. The glands of steel, bronze lined and capped. It is fitted up so that the direct shear movement works through a rectangler guide having extended surface for the resistance in cutting heavy plates. The return stroke is made by the direct pull back cylinder on the top of the main cylinder and directly connected with the guide carrying the shear blades. It is conveniently arranged with a bronze balanced type of valve of Mr. Wood's latest type and is very convenient and direct for handling and working of the machine, either by hand or by foot. On account of the excessive pressure at which the shear is worked great care has been taken in the materials used in its construction. The shear when it was completed weighed about 22,000 pounds.

Appraising and Bankrupting the Railroads.

In an able article on the above subject the Saturday Evening Post of Burlington, Iowa, says that several years ago Congress passed a measure which provides for the physical valuation of all railroad property in the United States. The idea was to secure a firm basis on which to erect schedules of rates fair to the shipper and remunerative to the carrier. A fund of two millions was provided for in the act to defray the cost of making the valuation. There were pessimists who held out that the job would require at least six months, but no one believed that the two millions could be spent. All this was four or five years ago. Since then additional appropriations have had to be made to keep the work going. The scope of the survey and conclusion has taken on new meanings and extensions not dreamed of in the beginning. And the work of valuation has now got only fairly started. The experts have been figuring on length of time needed to complete the task, basing their estimates on what has been done to date—and their summing up is that the job will require the services of 10,000 men for 38 years and will cost in the neighborhood of 266 millions of dollars. One-half of the expense of valuation is borne by the roads and the remainder by the government. The conclusion to be reached from such a muddle is that the whole matter was hatched for the purpose of adding on to the salary list and to create soft berths for a lot of loafers. When everyone has obtained some sort of an office in this country who will till the soil and produce the food we eat?

Mail Pay Insufficient.

In the war over the proper pay for a railroad handling a pound of mail, the railroads claim that the Government is not paying them sufficiently for carrying the mails, and the Government is just as loud in its denials and counter assertions that the railroads are overpaid. Incidentally, no railway mail pay legislation was enacted at the last session of Congress as a result, and now both sides are preparing for a display at the December session of Congress. Chairman Moon of the Congressional committee seems to be [illegible] with the spirit of driving a good bargain and "saving millions for the Government." But the public, who must support the railroads through the passenger, freight, express and mail tolls, certainly expects the Government to bear its fair share. A million clipped off the mail pay will mean a million added somewhere else. One Congressional committee has already submitted a report favoring more liberal compensation, and Congress should either accept its finding or be in a position to prove its falsity.

But more important than all other considerations is the question of ethics. The Government has the power to compel the railroads to carry the mails at a loss, possibly, but its power should not be so misused. A government that demands frank

FRONT VIEW WOOD'S HYDRAULIC SHEAR

and honest dealing between the business men of the nation should take every opportunity to set an example

Coming in on Time.

The Broadway Limited of the Pennsylvania, between New York and Chicago, 900 miles in 20 hours, was on time for 92 per cent. of its trips during the first six months of this year and was two minutes late on only 15 of a total of 181 days. Eastbound, it was on time for 163 days, and on time or not more than five [illegible] of its trips. In June it was on time every day.

Electrical Department

Electrostatic Potential and Synchronism Indicators

[illegible] tential on high voltage a c. circuits, and [illegible]

For indicating potential, two appliances as shown in Figs. 1 and 2 have been developed by the General Electric Company. The first consists of an electrostatic glower, a metallic condenser hood, a switch for cutting the glower in and out of circuit, and a hook for suspending the indicator from the line and leading current to the glower. One terminal of the glower is connected to a spark gap and then to the lower end of the suspension hook; the other terminal, to the condenser hood. [illegible] the line by means of the ordinary type of switch hook used for operating disconnecting lever switches.

[illegible] vides a low resistance path between the line and the hood and cuts the glower out of circuit. When the switch is open the glower is connected between the line and hood through the spark gap, and will light up if there is potential on the line at least equal to the tension between the line and ground on a three-phase system carrying 15,000 volts. This indicator is used for indoor and outdoor service, and, as a rule, hangs on the line continually, but, of course, can be moved about as desired [illegible] the switch string sufficiently close to the hood to be out of reach of the operator.

The second form of indicator, shown in Fig. 2, is essentially the same as just described, except that no switch is provided and the hood is attached to a long wood rod equipped with a ground cone [illegible]

[illegible]

ground. The upper terminus of the lead running down to the spark gap inside the [illegible] to the top of the pole to a metal pin, which is held against the line to determine whether the line is alive. This indicator is, because of its easy portability, most suitable when the indication of potential may be desired on a number of lines.

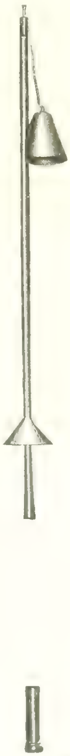


FIG. 2. PORTABLE ELECTROSTATIC POTENTIAL INDICATOR

In using an electrostatic indicator one should always bear in mind the fact that, although the lighting of the glower gives a positive assurance of voltage on the line, the lack of glow does not by any means prove the line to be dead, because the bulb may be broken, the leads disengaged, the potential too low, etc.

The usual method of indicating when a-c. lines or machines may be thrown together is by the use of a synchronism indicator and synchronizing lamps, or by either the indicator or lamps separately, employing also as a rule the potential transformers that are used in conjunction with the meters or instruments. This arrangement is entirely satisfactory; but when it is desired to connect systems together where transformers are not needed for indicating or measuring purposes, the equipment is comparatively expensive. The higher the voltage, the more does this apply.

The electrostatic synchronizer of the General Electric Company, shown in Fig. 3, requires for operation, however, only the charging current of the line. It consists of a few simple and inexpensive parts, and can be used to considerable advantage in main stations where current is metered on the low side, in switching stations, line junction stations and some substations.

Three electrostatic glowers, mounted in a case, which resembles that used for a round pattern switchboard instrument, are used for each synchronizer. The glowers are connected to the line through condensers consisting of suspension insulators, the insulating value of which is at least equal to that used for insulating the line.

To use the synchronizer the terminals of one of the glowers are connected through the insulators to the leads of the same phase of running and incoming lines. The other glowers are each connected across dissimilar phases of the remaining leads of the running and incoming lines.

When the lines are not in synchronism the glowers will indicate the relative frequency of the lines in the same manner as the usual synchronizing lamps. When in synchronism the rotating effect will disappear, the glower connected to the corresponding lines will be dark and the other two will show about one-half brilliancy. The minimum voltage for operation is 13,200, and the maximum depends only on the use of the proper number of insulators.

The synchronism indicator can be used as a ground detector by connecting one

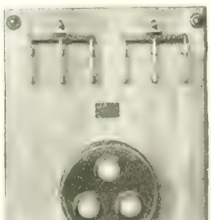
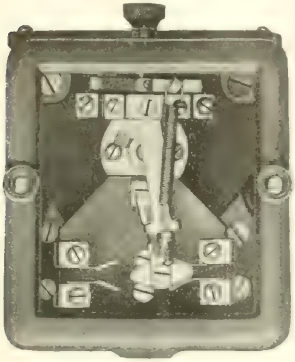


FIG. [illegible] ELECTROSTATIC SYNCHRONIZER OF THE GLOW POTENTIAL INDICATOR TYPE

terminal of each glower to ground and the other terminals to the line. A lighted glower will indicate that the line is at potential above ground, i. e., not grounded.

Protection of Single A.C. Tie Lines.

Single-pole, double-throw relays of the type illustrated have recently been developed by the General Electric Company. These relays provide a simple and effective means of isolating trouble automatically on a single tie line joining parts of an alternating current system. Two relays connected together by pilot wires



TOP VIEW OF TYPE R FORM [illegible] COMBINED CIRCUIT OPENING AND CLOSING ALTERNATING CURRENT REVERSE POWER RELAY.

are required on each end of a three-phase tie.

Under normal conditions, irrespective of the direction of the power, which may reverse at any time over the entire tie line, depending on the distribution of the load and the characteristics of the system, the relays have no effect on the oil switches. If, however, a short circuit occurs in the tie line while power is being fed from one part of the system to the other, this power will go directly into the short, while the power in the tie between the short and the part of the system previously receiving power will reverse and also feed into the short. This will operate the contacts of the relay in the reversed portion of the line, which will cause the oil switches on both ends of the line to trip and isolate the line from the rest of the system.

The relays will not operate on overload, or on trouble on other lines unless accompanied by a reversal of power only on one end of the line which they are meant to protect. They will, however, operate on very little reverse power, even at low voltage and low power-factor, and are consequently of great value for the service recommended.

Progress of the Mechanical Drawn Vehicle.

Our Glasgow agent, Mr. A. Fraser Sinclair keeps the readers of the Glasgow *Herald* well informed on everything relating to automobiles and motor trucks by weekly articles which he contributes to that well known paper. The following article on motor car traffic will interest most of our readers.

The census of motor vehicles taken annually in London by a firm of newspaper publishers is a useful guide to the progress of that great movement which has for its object the substitution of mechanical haulage for animal drudgery. It is true that the census if taken as representative of the United Kingdom would be misleading, but it is too well known among present-day readers that London traffic is quite exceptional for any such misunderstanding to occur. At the same time it might be well if "Motor Traction"—from which the following figures are taken—were to make it clear that a huge difference exists. This is the more to be desired that the paper appears to take some interest in how posterity may regard the matter. The recent census was the eleventh, the first having been taken in 1905. In that year there were no motor omnibuses crossing Putney Bridge on the day the census was taken, yet in the year following they numbered over 800 in one Sunday. It took four years more, however, for the horse 'bus to be beaten in numbers, but so rapidly was the change effected that by 1911 motor omnibuses constituted 95 per cent. of the whole, and a year later horse 'buses were virtually obsolete. If the transformation among cabs has not been so complete as in the case of omnibuses, the fact is due to the existence of the light horse-drawn hansom. Nevertheless in 1910 the [illegible] were about equal, and by the following year the number of horse cabs had fallen to 20 per cent. of the total. In London the business or commercial vehicle has always been a weak point. While public bodies have shown a laudable desire to substitute mechanical [illegible] the business community have been less enterprising so far as the heavier type of [illegible] tive business thoroughfare, Edgware Road, [illegible] commercial [illegible] of the whole, while [illegible] even less, being but 70 per cent. So far as private motor vehicles are concerned the Putney Bridge figures are enlightening. This type of vehicle was, of course, the first to be used, and it is therefore not surprising that by 1905 the number counted on a Sunday formed 40 per cent. of all private carriages. Four years later they were 80 per cent., and today they constitute 98 per cent. of the private carriage traffic.

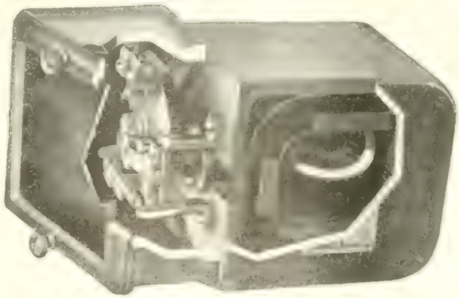
Making Calcium Carbide.

Calcium carbide is the material from which the flame of acetylene lights are made, and is a very valuable substance. We learn from the *Scientific American* that an electro-chemical establishment lately installed near Johannesburg is designed to manufacture calcium carbide and nitrate by a new process. It is stated that there are now running on this principle 400-kilowatt furnaces using single phase current for the production of carbide. Calcium nitrate, which is used as a fertilizer, is produced by six furnaces operated on the 3-phase system of 2,600-kilowatt size. To secure the current the present plant demands a large hydraulic plant that cost over a million of dollars and operates by power an adjacent stream.

Milwaukee Road Orders Heavy Engines.

The Chicago, Milwaukee & St. Paul Railroad has placed an order for five of the biggest type locomotives built by the American Locomotive Company for freight service in order to be ready to handle the expected enormous grain business from the West this fall.

The road is busily preparing to put its locomotives now in shops into commission, and is overhauling freight cars to [illegible] ninety-five idle locomotives formerly used constantly on regular freight business, and [illegible] full service at an early date.



[illegible] CLOSING [illegible] REVERSE POWER RELAY.

Items of Personal Interest

Mr. Charles [illegible] has been appointed master boiler maker of the Virginian railway, with office at Princeton, W. Va.

Mr. R. A. Lunsford has been appointed storekeeper of the Kansas City, Mexico & Orient, with offices at San Angelo, Tex.

Mr. F. F. Carey has been appointed acting district master mechanic, on the Intercolonial Railway, District No. 3, at Moncton, N. B.

Mr. A. M. [illegible] has been appointed signal supervisor of the Canadian Government railways with headquarters at Moncton, N. B.

Mr. W. S. Robertson, assistant to the vice-president of the American Locomotive Company, has been chosen secretary of the company.

Mr. C. Connors has been appointed district master mechanic on the Ontario division of the Canadian Pacific, District No. 1, at Toronto, Ont.

Mr. G. H. Robinson has been appointed general storekeeper of the Oregon Short Line at Pocatello, Idaho, succeeding Mr F. A. Martin, promoted.

Mr. Charles B. McElhany, general manager of sales of the Cambria Steel Company, has been elected also a vice-president of that company.

Mr. J. A. McRea has been appointed mechanical engineer of the Louisville & Nashville, with office at the South Louisville shops, Louisville, Ky.

Mr. Charles Edelman has been appointed signal supervisor of the Missouri Pacific with office at Osawatomie, Kan., succeeding Mr. A. Dewey, transferred

Mr. Joseph P. Heinzer has been apponted road foreman of engines of the Northern Pacific, with office at Pasco, Wash., succeeding Mr. R. E. Wilkinson.

Mr. L. H. Douglas has been appointed master carpenter of the Baltimore & Ohio with office at Akron, Ohio, succeeding Mr. J. T. McIlwain, assigned to other duties.

Mr. H. L. Shipman, formerly apprentice instructor on the Santa Fe at Albuquerque, N. M., has been appointed equipment instructor on the same road with office at Topeka, Kan.

Mr. L. G. Roblin has been appointed general master mechanic of the Natural Transcontinental and the Lake Superior branch of the Grand Trunk Pacific, with office at Cochrane, Ont

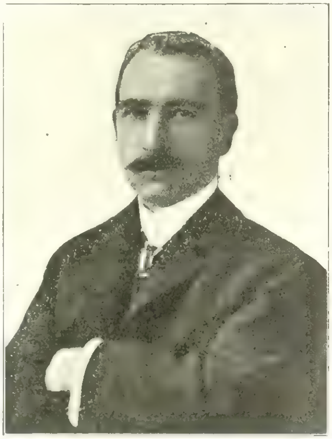
[illegible] master mechanic of the Texas & Pacific, has been appointed master mechanic of the International & Great Northern with office at San Antonio, Tex.

Mr. Charles Manley, master mechanic of [illegible] Harrison, Ark., has assumed the duties also of general storekeeper and the office of the latter is abolished.

Mr. A. P. Jander, formerly foreman on the Atchison, Topeka & Santa Fe railway at Raton, New Mexico, has been appointed general foreman on the same road, with office at Trinidad, Colo.

Mr. E. G. Buckland has been elected president and director of the Central New England Railway, with offices at New Haven, Conn., and at Burton, Mass., succeeding Mr. Howard Elliott, resigned.

Mr. E. F. Vincent, formerly assistant chief engineer of the Colorado & Southern, has been appointed chief engineer



MALCOLM MACLEOD

on the same road, with office at Denver, Colo., succeeding Mr. H. W. Cowan, deceased.

Mr. L. C. Fritch has been appointed general manager of the Canadian Northern with offices at Toronto, Ont., and will also continue as assistant to the president on that road.

Mr. J. E. Love, formerly structural engineer on the Chicago, Milwaukee & St. Paul, at Butte, Mont., has been appointed engineer for the board of railway commissioners for the State of South Dakota

Mr. Owen W. Middleton, formerly editor of the Railway Master Mechanic, has been appointed publicity manager of the American Steel Foundries, with headquarters in the McCormick building, Chicago.

Mr. Henry Bartlett, formerly mechanical superintendent of the Boston & Maine, has been appointed chief mechanical engineer of the same road, and will have charge of all matters connected with motive power and other equipment.

Mr. T. C. Kyle, formerly general foreman of the Kansas City, Mexico & Orient at Wichita, Kan., has been appointed master mechanic on the same road at San Angelo, Tex., and Mr. Victor S. Kirk succeeds Mr. Kyle as general foreman at Wichita.

Mr. H. A. Herndon, formerly chief draftsman of the Fort Worth & Denver City at Childress, Tex., has been appointed junior mechanical engineer, division of valuation, of the Interstate Commerce Commission, with headquarters at Kansas City, Mo.

Mr. M. T. Cogley has been elected president of the Texas-Mexican, with office at Laredo, Tex. Mr. S. W. De Wolf, formerly general superintendent at Laredo, Tex., has been elected to the position of vice-president and general manager, with office at Laredo, Tex.

Mr. Patrick Baker, roundhouse foreman of the Cincinnati, Hamilton & Dayton, at Indianapolis, Ind., has been appointed general foreman at that point, succeeding Mr. W. E. Greenwood, who has been appointed master mechanic on the Baltimore & Ohio Southwestern, with office at Flora, Ill.

Mr. H. J. White, general car foreman, has been appointed supervisor of car work of the Canadian Northern on all lines east of Port Arthur, with headquarters at Toronto, Ont., and Mr. T. C. Hudson, division master mechanic at Johette, Que., has had his jurisdiction extended over the car department of the Quebec lines.

Mr. M. A. Evans, western sales manager of the Railway Appliances Company, Chicago, at the time that company was bought by the Q. & C. Company, New York, and with the latter company temporarily during the reorganization period, has resigned. Mr. Evans will take a short vacation before returning to the railway supply business.

Mr. William A. Del Mar has resigned from the electrical engineering department of the New York Central & Hudson River Railroad to become assistant electrical engineer of the Interborough Rapid Transit Company, of New York. He is the author of "Electric Power Conductors" and some sections in Pender's "American Electrical Engineers' Handbook." He is a member of the A. I. E. E., the A. E. R. A. and the A. R. E. E. and is an associate member of the I. E. E. of England.

Mr. Malcolm H. MacLeod, of Winnipeg, the accomplished general manager

and chief engineer of the Canadian Northern, is from the Isle of Skye, Scotland. He has been engaged in railroad work since 1878, and is considered one of the best informed railway men in America. Prior to being engaged on the Canadian Northern Mr. MacLeod was chief engineer of the Crow's Nest division of the Canadian Pacific. From thence he was appointed chief engineer on the Canadian Northern. This was in 1900. He has been the recipient of many testimonials to his high qualities, among others a handsome testimonial from Prince Arthur of Connaught.

Mr. Horace Field Parshall, formerly chairman of the Central Underground Railway, England, will have charge of the physical property of the Barcelona Traction, Light & Power Company, of Barcelona, Spain, as a result of changes in administration of the company following the death of Dr. F. S. Pearson. Mr. Parshall is an American, but has resided in England for the past 20 years. He served as electrical engineer for the Dublin Tramways, the Glasgow Tramways, the London United Tramways and the Bristol Tramways. He prepared the plans for the Central London Underground Railway installation and was associated with the work on the Central Underground Railway for more than 10 years.

L. C. SPRAGUE

Mrs. E. F. Gould, assistant general manager and mechanical and electrical engineer of the Aurora, Elgin & Chicago Railroad, of Wheaton, Ill., has resigned to become consulting engineer in the Cleveland office to act in a supervisory capacity over all the properties in which Mandelbaum, Wolf & Lang are interested. Mr. Gould entered the employ of the Aurora, Elgin & Chicago Railroad in 1903 as a mec[illegible] and electrical engineer and finally [illegible] general manager. Prior to 1903 he was for four years connected with the railway engineering department of the General Electric Company at Schenectady, and for a number of years he has been consulting engineer for the Western Ohio Railroad at Lima, Ohio.

In the appointment of B. C. Tracey as supervisor of electric welding of the Baltimore and Ohio railroad, with jurisdiction over this work in all shops on the system, circular of which has been issued by F. H. Clark, general superintendent of motive power, it is believed that one of the youngest men ever appointed to an official position on an American railroad has been promoted. Mr. Tracey is a youth in his early "twenties," whose railroad career is an example of the training which the corporation gave the young man to fit him for his life's work. Entering the service as a messenger boy, he was taught elementary studies in a night school supported by officials of the Baltimore and Ohio and other business men of Baltimore. Later, he was entered in the railroad's course for shop apprentices and given an opportunity to specialize in electric welding.

Mr. L. C. Sprague, who has been appointed motive power inspector of the Baltimore & Ohio, with office at Baltimore, Md., has had an interesting career as a railroad man of wide experience. He entered the service of the Chicago, Burlington and Quincy at Galesburg, Ill., in 1901, as locomotive fireman. He was transferred to lines west of the Missouri river as engineer of the official inspection engine in 1909. In 1912 he was transferred to the office of the Fuel engineer as Fuel insepctor. In the same year he entered the service of the International correspondence School as locomotive and air brake instructor. In 1914 he entered the service of the Great Northern as assistant general air brake inspector, which position he held until the present appointment on the Baltim[illegible] & O[illegible]. Mr. Sprague is generally acknowledged to be one of the leading experts in America on locomotive and air-brake inspection.

Traveling Engineers Take Notice.

The secretary of the Merchants' Association of New York has written the following letter to the president of this publication and we respectfully commend its contents to the members of the Traveling Engineers' Association:

May we [illegible] with your co-operation in an effort to bring to this city the 1916 meeting of the Traveling Engineers' Association? This organization never has convened here. We believ[illegible] advantage [illegible] lief is b[illegible] bership in the east is not as strong as it ought to be, and lately the interest of the eastern members has not been especially lively.

If the meeting were held here in 1916 there undoubtedly would be an increase in membership in the eastern territory and a quickening of interest on the part of the present eastern membership. Further than this, it is entirely probable that the attendance here would be very large because every engineer would welcome the opportunity to visit New York City and inspect our wonderful terminals and the many other features of technical interest. If the meeting is held here there will be provided for it, without charge, ample space for the exhibition as well as adequate meeting and committee rooms, and the very best hotel accommodations will be available at reasonable rates. The eastern lines will be glad to do their part in making things pleasant for the visitors. We should be pleased indeed to extend our co-operation in all the details of arrangement for and conduct of the convention and you may be sure that we should do our best to make it a success from a business standpoint as well as a pleasantly memorable occasion.

If you attend the meeting at Chicago next month we trust that you will record your vote for New York City. If you cannot be present, we take the liberty of suggesting that you write Secretary Jackson and recommend that the Association meet here next year.

Assuring you that your co-operation will be appreciated,

THE MERCHANTS' ASSN. OF NEW YORK.

[It seems to us that it would be right and proper for the Traveling Engineers' Association to hold its 24th annual convention in New York City since the first meeting was held in the office of LOCOMOTIVE ENGINEERING, which still holds forth in New York.]

Messrs. Joseph T. Ryerson & Son, Chicago, have established an up-to-date new warehouse at Jersey City, from which immediate shipments of iron, steel and machinery will be made for the Canadian trade. The firm has been well known for three-quarters of a century. Each year has witnessed great expansion, and the facilities of the Ryerson plants have been extended until now three groups of warehouses, in New York, Chicago and St. Louis, serve the steel buyer with everything in iron, steel and machinery, from the largest structural shape to the smallest cotton[illegible]

[illegible]ide of Hu[illegible]

[illegible] wore the hair shirt all my life [illegible] a seat [illegible]er there with Brother Hall and [illegible]

Baldwin Locomotive Works Design a Quadruplex Compound Locomotive.

We have read the reports which have been [illegible] in regard to the performances of the Erie Triplex Compound locomotive has induced Mr. G. R. Henderson, consulting engineer to the Baldwin Locomotive Works, to propose a quadruplex design. This is only in the proposal stage, but this, or even more than this, is not beyond accomplishment, and may be realized sooner than might be imagined. The design includes two pairs of high-pressure and two pairs of low-pressure cylinders, so that there are two cylinders for each set of eight-coupled wheels. The firebox is of special design with combustion chamber, and as it must needs be, in view of its enormous length, is equipped with a Street mechanical stoker. The barrel proper, with a coned ring in front, is 17 ft. long from the back tube plate, and in front is virtually a second boiler, for 22 ft. tubes, the two sections being connected by an intermediate combustion chamber which is formed with an "accordion" joint, as was done for an engine on the Atchison, Topeka and Santa Fé Railroad a few years ago. Without such an arrangement [illegible] would [illegible] quite impossible, as a degree of flexibility is imperative.

Leading dimensions are as follows:

Gauge of road, 4 ft. 8½ in.; working pressure, 215 lb. per sq. in.; tractive power, 200,000 lb.; cylinders, high-pressure, diameter 27, stroke 32 in.; cylinders, low-pressure, diameter 41, stroke 32 in.; drivers, diameter 60 in.; firebox, type radial stays; firebox, length 198, width 108 in.; valve motion, Walschaerts; superheater type, Schmidt.

Heating surface: Firebox, 400 sq. ft.; flues, front, 5,800 sq. ft.; flues, back, 4,500 sq. ft.; fire-arch tubes, 50 sq. ft.; total, 10,750 sq. ft.; grate area, 160 in. by 108 in., 120 sq. ft.; superheater, 1,400 sq. ft.

Weights in working order: Truck, 35,000 lb.; drivers, 800,000 lb.; trailer, [illegible]

Tender: Water capacity, 10,000 gals.; fuel, 15 tons.; tank, weight loaded, 250,000 lb.

Improved Railway Returns.

Recent reports to the Interstate Commerce Commission in regard to railroad earnings show that the only thing the matter with the better transportation systems of the West and the South is a traffic rate too low to permit them to give a first-class service and make a decent living.

With the increased rate granted them by the commission the Eastern carriers have been doing so much better since the early part of the year that those thus far reporting for June show their net revenue a mile made a gain of nearly 23 per cent., with a rise from $618 a mile in June of last year to $758 in June this year. But the Western lines thus far reporting for June went up in net earnings only from $276 a mile to $314 a mile, or some 10 per cent., while the gain of the Southern lines thus far reporting is scarcely traceable, having moved only from $168 to $172.

As the eighty-nine railroads whose returns make up these figures represent about half the mileage of the country, it is probable that the figures for all the roads will not show a great difference from those results we have just explained. In any event, there is no doubt that the Eastern railways, with the very careful economies they must still practice, are thriving reasonably; but the Western roads, with the practice of the same rigid economies, but without a living rate yet granted to them by the Interstate Commerce Commission, are not very far over the line of safety, while the Southern roads are decidedly on the ragged edge.

The Interstate Commerce Commission can't fail to do for the other carriers [illegible] because the very reports given out by the commission prove that it is imperative that it be done if all those railways are [illegible]

Brotherhood of Trainmen Fighting Legislation.

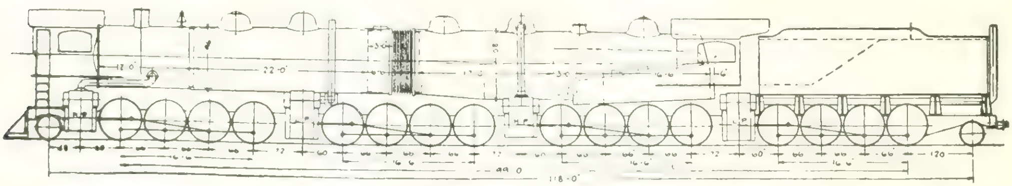
The Brotherhood of Railroad Train[illegible] campaign to defeat every candidate for the Assembly in the November election who will not pledge himself to support all legislation that affects trainmen. They want a law to limit the length of freight trains to half a mile, and they are determined to keep the full crew law on the statute books.

A bill was introduced into the New York Assembly last winter providing that the regulation of train crews should be placed in the hands of the Public Service Commission—a very sensible measure, but it was defeated by the efforts of the trainmen's organization.

John Fitzgibbons, legislative representative of the Brotherhood of Trainmen at Albany, N. Y., has sent a letter to the members of the brotherhood of the State, part of which reads:

"Last winter we had a hard fight to keep the Full Crew law on the statute books of this State, a fight that cost our organization considerable time, effort and money. Let each lodge of the Brotherhood of Railroad Trainmen take a copy of my report and turn to the page which contains the list of names of the assemblymen who voted against our Full Crew law at the last session of the Legislature. If you find that the assemblyman from your district voted against your interest last winter, don't stop pounding him until you are successful in defeating him for re-election, no matter what his politics may be, whether Democrat or Republican."

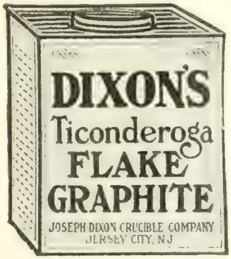
John Fitzgibbon is a particularly aggressive labor leader, and railroad companies will require to follow strong self-protective measures if they do not care to have the real management of railroad performed by the Brotherhood of Railroad Trainmen.



PROPOSED [illegible] DOUBLE COMPOUND [illegible] DRIVER QUADRUPLEX LOCOMOTIVE DESIGNED BY THE BALDWIN LOCOMOTIVE WORKS.

Bronzing Cast Iron.

Thoroughly cleanse the metal and rub it smooth. Apply evenly a coat of sweet or olive oil and heat the iron, being careful that the temperature does not rise high enough to burn the oil. Just as the oil is about to decompose, the cast iron will absorb oxygen, and this forms upon the [illegible] which [illegible] will [illegible] polish.



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RAILROAD NOTES.

The Florida East Coast has ordered 2,200 tons of steel rails.

The Gulf Florida & Alabama has ordered 6,000 tons of 80-lb. rails.

The Erie Railroad has ordered 50 locomotives from the American Locomotive Company.

The Philadelphia & Reading has placed an order for steel rails of approximately 5,000 tons.

The Russian government has placed an additional order for 2,000 cars with a Pittsburgh firm.

The Baltimore & Ohio has placed orders for 2,000 freight cars and 50 passenger cars.

The Delaware & Hudson Company is reported to be asking bids on 25 passenger and baggage cars.

The Southern Railway has commenced installing an additional 77 miles of electric block signals.

The Lehigh Valley is reported preparing plans for new shops at Buffalo, N. Y., to cost about $250,000.

The Atlantic Coast Line has ordered 750 box cars from the Mt. Vernon Car Manufacturing Company.

The Atlantic Coast Line has ordered 10 Pacific type locomotives from the Baldwin Locomotive Works.

It is stated that the Northern Railway of France has placed orders for 1,300 freight cars in this country.

The United States Steel Corporation has taken an order for 65,000 tons of rails for the Russian government.

The Russian Government is reported to have ordered 100,000 tons of rails from the Maryland Steel Company.

The Pennsylvania Lines West of Pittsburgh are in the market for 200 steel underframes to reinforce cabin cars.

The Gadsden Car Works, it is said, has ordered 600 underframes from the Mt. Vernon Car Manufacturing Company.

According to the reports, the New York Central is in the market for 2,000 all-steel freight cars for the Michigan Central.

The Cumberland Valley has plans for building [illegible] terminal improvements at [illegible]town, Md.

The Cleveland Cincinnati Chicago & St Louis Ry. will build 5 Pacific type (4-6-2) locomotives at its Beech Grove, Ind., shops.

The Seaboard Air Line has been getting bids on a large number of new shop tools for the repair shops being built at Portsmouth, Va.

The New York Central has ordered 500 50-ton all steel automobile cars from the Haskell & Barker Car Company for the Michigan Central.

The Shevlin Hixon Company, Minneapolis, Minn., has ordered one 60-ton three truck Shay locomotive from the Lima Locomotive Corporation.

The Philadelphia & Reading has ordered 8,000 tons of rails from the Pennsylvania Steel Company and 2,000 tons from the Bethlehem Steel Company.

The Nashville, Chattanooga & St. Louis has ordered 3 Mallet (2-8-8-2), 5 Mikado and 2 Pacific type locomotives from the Baldwin Locomotive Works.

The United States Portland Cement Company, Concrete, Colo., has placed an order with the Baldwin Locomotive Works for one 4-wheel switching locomotive.

The International & Great Northern has ordered 500 box cars, 300 gondolas and 200 stock cars from the Mt. Vernon Car & Manufacturing Company, Mt. Vernon, Ill.

The Wisconsin & Northern has ordered 1 superheater ten-wheel type locomotive from the American Locomotive Works. This locomotive will have 20 by 26-inch cylinder; 63-inch driving wheels and a weight of 168,000 lb.

The Baltimore & Ohio has divided an order for 1,000 100,000-pound capacity steel hopper car bodies among the Standard Steel Car Company, the Pressed Steel Car Company and the American Car & Foundry Company. These car bodies will be placed on trucks rebuilt in the company's shops.

The South Dakota Central has ordered one ten-wheel and one Mikado type locomotives from the American Locomotive Company. The ten-wheel locomotive will have 18 by 24-inch cylinders, 60-inch driving wheels and a total weight of 136,000 pounds. The Mikado type locomotive will have 20 by 28-inch cylinders, 52-inch [illegible]

A Railroad Humorist.

The famous humorist Robert J. Burdette has made railroad matters the subjects of many of his amusing sketches, and he appears to have been much attracted to railways, in which he followed for a brief period as passenger train brakeman on the Burlington Road. After that he became a reporter on the Burlington *Hawkeye*, where his most famous work was done. He was of French-Scotch parentage, a combination that has produced many persons of winning ability. One of the best serious things Burdette wrote was an advice to boys, which reads:

"Remember, my son, you have to work. Whether you handle a pick or a pen, a wheelbarrow or a set of books, digging ditches or editing a paper, ringing an auction bell or writing funny things, you must work. If you look around you you will see the men who are most able to live the rest of their lives without work are the men who work the hardest. Don't be afraid of killing yourself with overwork. It is beyond your power to do that on the sunny side of thirty. They die sometimes, but it is because they quit work at six p. m. and don't get home till midnight. It is the interval that kills, my son. The work gives you an appetite for your meals; it lends solidity to your slumbers; it gives a perfect and grateful appreciation of a holiday. There are young men who do not work, but the world is not proud of them. It does not even know their names; it simply speaks of them as 'old So-and-So's boys.' Nobody likes them. The great, busy world does not know that they are there. So find out what you want to be and do, and take off your coat and do it. The busier you are the less harm you will be apt to get into, the sweeter will be your sleep, the brighter and happier your holidays, and the better satisfied will the world be with you."

Were Not Aware That Walking on Track Was Prohibited.

The persistent demand for safety first in railroad operating appears to be yielding some fruit meet for repetition. On one Sunday last month 15 persons were arrested for trespassing on a single section of the New York Central Railroad. [illegible] with the crime of trespassing upon a railroad they were the most surprised crowd that ever appeared in court. Every one protested that they were not aware that [illegible] the railroad track. They were all let off on being lectured concerning their ignorance of the law of their own State.

American Railroads.

The overwhelming leadership of the United States as a railway nation is shown in a comparison of individual countries, for after its 254,8[illegible] miles (including 653 for Alaska), Germany is second with only 39,513 miles, while European Russia is third with 38,563. Then follow in order, British East India, 34,572; France, 31,737; Canada, 29,233; Austria-Hungary, 28,641; Great Britain, 23,385; Argentina, 20,593; Mexico, 15,805; Brazil, 15,491; Italy, 10,933; Spain, 9,517; Sweden, 8,984, and Japan, 6,811.

Railroad Master Blacksmiths' Convention.

The twenty-third annual convention of the International Railroad Master Blacksmiths' Association was held at the Hotel Walton, Philadelphia, Pa., August 17, 18, 19. Interesting papers were read and discussed on the subjects of Flue Welding, Making and Repairing Frogs and Crossings, Piecework, Reclaiming Scrap, Spring Making, Case Hardening, and Electric Welding. Mr. C. E. Chambers, superintendent of motive power of the Central Railroad of New Jersey, delivered an able address on the importance of blacksmithing in railroad work.

The following officers were elected for the next year: President: T. E. Williams, Bettendorf Company; first vice-president, W. C. Scofield, Illinois Central; second vice-president, John Carruthers, Duluth, Missabe & Northern; secretary-treasurer, A. L. Woodworth, Cincinnati, Hamilton & Dayton; assistant secretary-treasurer, George B. White, Missouri, Kansas & Texas; chemist, G. H. Williams, Boston, Mass. Chicago received the largest number of votes as the place of meeting for the next convention.

It is a familiar though that the unbelief of today is the belief of tomorrow, and yet today always condemns the premature tomorrow. The skepticism of honest men unfolds the truth and becomes the conviction of after-time.

No cheating or bargaining will ever get a single thing out of nature's "establishment" at half price. Do we want to be strong?—we must work. To be hungry?—we must starve. To be happy?—we must be kind. To be wise?—we must look and think.

We soon learn that it is possible to visit many nations and see less, on the whole, than if one had stayed at home; and that it is easy to say nothing through a great [illegible]

It seems to be of little importance what [illegible]

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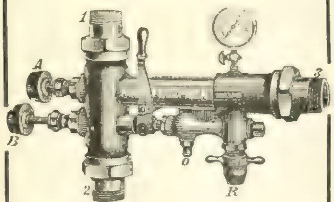

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Locomotive Engine Running and Management.

[illegible] by Angus Sinclair, D. E., and published by John Wiley & Sons, New York, has just been issued. It extends to 436 pages, fully illustrated, and sells at two dollars per copy. In the thirty years that have elapsed since the first appearance of this work many important changes have been made on the design and operation of the locomotive, but each successive edition of this work has kept pace with the changes in construction and methods of working, with the result that the demand for the book continues with the coming years, and the railroad man of today finds it as invaluable as those of the last generation, and the present edition is, in every way, a worthy successor to the many extensive editions that have been published. The book retains all the elemental features that are so necessary and so clearly presented to the reader that nothing further need be desired as a foundation of a thorough knowledge of the details of the locomotive, and superadded to this are new features that render the present edition of more value because for the first time the electric locomotive is described, the Air Brake Catechism presents the latest improvements in that important appliance, the Mallet compound locomotive has also a special chapter, and, in brief, the revision of the book is at once masterly and complete.

Report of the Smithsonian Institution.

As we have said [illegible] of printed books that appear from time to time Government reports are the dullest. To read them is impossible. Even the waste paper man looks askance at them. Of course, they have their uses. A certain number of printers and paper makers and binders are employed in presenting the balderdash in the semblance of a book, and no matter how soon the enormous edition finds its way to the waste paper mill it must all be paid for by the long-suffering taxpayer. The Annual Report of the Board of Regents of the Smithsonian Institution is a notable exception, however. Large portions of it are positively interesting. It touches everything on the earth, the heavens above and the waters under the earth. It reaches from the glacial caves of the antartic regions to the Belt of Orion. With a copy of this year's report on hand we need not mind going to the Zoological gardens. Like Noah's ark [illegible] then there are ancient vases and [illegible] looms, and Hittite divinities. [illegible] Irish stew, it is difficult to describe [illegible] must be possessed to be appreciated. [illegible] fice, Washington, D. C., and although a [illegible]

Proceedings of the Air Brake Association.

The proceedings of the twenty-second annual convention of the Air Brake Association held in Chicago, Ill., last May now appear in book form, extending to 285 pages, bound in flexible leather and copies may be had from the secretary, 53 State street, Boston, Mass. Price, $2.00. Besides a complete report of the papers submitted to the convention and the discussions on the same, a copy of the constitution and by-laws, and a complete list of members and their addresses is also added. A carefully prepared index fittingly closes the volume, which is in many respects a valuable addition to the railroad literature of our time. As is well known the rapid increase in the weight of rolling stock has rendered the air brake appliances subject to continual and involved change, and it would sometimes seem as if we were no nearer than ever to a fixed set of appliances, and it is no easy matter keeping pace with the rapid changes called into use from time to time.

Electrical Measurements and Meter Testing.

[illegible] of electrical engineering at the Armour Institute of Technology, Chicago, Ill., has written an excellent book on the above subject suited to the requirements of practical men who desire a thorough knowledge of the important subject of meters. The first five chapters treat of the fundamental principles of electricity, the remaining eight chapters treat of electrical measurements and the construction, operation and calibration of the instruments used in making such measurements. It is but just to state that the book is the last word in practical meter engineering. The style is clear and thorough. The book is the handy pocket size, 328 pages, 191 illustrations and reference tables, limp cloth binding, $1.00. Full leather, red edges, gold stamping, $1.50. Frederick J. Drake & Co., Publishers, 1325 Michigan avenue, Chicago, Ill.

Proceedings of the International Railway Fuel Association.

The Seventh Annual Convention of the International Railway Fuel Association [illegible] may be had through the secretary, Mr. C. G. Hall, 922 McCormick Building, Chicago, Ill. The importance of the subjects

[illegible] is emphasized by the fact that of the 510 millions of [illegible] the production of the United States during the year 1914, approximately 70 per cent. was taken over for railroad consumption, and it is the aim of the association that this vast amount of fuel should be utilized in the most careful and economic manner. To this end special committees are appointed [illegible] phase of the fuel subject. Individual papers also of particular merit appear from time to time. Among these a paper on "Powdered Coal," by W. L. Robinson, supervisor of fuel consumption, Baltimore & Ohio, attracted much attention and appears in the volume with the discussion attached.

"The Blue and the Gray."

"The Blue and the Gray" is the title of a historical booklet issued by the Baltimore & Ohio Railroad descriptive of battlefields on or near its lines, and which bear evidence of bitter conflicts which stirred the American people in Revolutionary days, during the Second War with England in 1812 and the Civil War. The battles on or near the Baltimore & Ohio, from the first engagement at Phillippi, W. Va., June 3, 1861, to General Lee's surrender at Appomattox Court House, April 9, 1865, are arranged chronologically for ready reference. One hundred and fifty-eight battles were fought on soil adjacent to the Baltimore & Ohio Railroad during the Civil War. The booklet is being distributed complimentary to students of history and tourists.

Westinghouse Electrification Data.

The Westinghouse Electric & Manufacturing Company has recently issued the first number of Westinghouse Electrification Data, a periodical to chronicle the latest advances in the field of heavy traction. The present number contains a discussion of electric locomotive characteristics, some interesting figures on the comparative maintenance costs of steam and electric locomotives, as well as data on the New York terminal electrification of the Pennsylvania Railroad.

Simplex Jacks.

[illegible] Central Avenue, Chicago, Ill., has issued a new edition of their illustrated catalogue [illegible] electric railroads, industries, automobiles, telephone and other purposes. Those who are familiar with the Simplex jack are well aware that some of the designs are [illegible] each having the quality of pivoting on its [illegible] lowers, pushes or pulls as may be desired. The jacks are designed for every kind of industrial service, and have stood the test wherever their services have been called into use. Those interested should send for a copy of the catalogue to the company's office and learn the important advantages possessed by the Simplex jacks.

Railway Sub-Stations.

Bulletin No. 44,090, recently issued by the General Electric Company on the above subject, gives an analysis of the equipment for various forms of up-to-date railway sub-stations, and specifies suitable apparatus for different voltages. The details of the apparatus required are given for permanent indoor and outdoor sub-stations, and as well for portable sub-stations. The bulletin is amply illustrated from photographs of typical installations, supplemented by detailed views of sub-stations apparatus, complete tables of rating and dimensions, together with drawings showing the location of the apparatus in both indoor and outdoor sub-stations. This bulletin should be of particular interest to the practical railway operator for the reason that, in addition to the data specified above, it gives a very comprehensive set of railway switchboard wiring diagrams.

Ideal Flue Tools.

Gustav Wiedecke & Co., Dayton, Ohio, has issued a new catalogue, No. 48, a unique publication of its kind. Its pages are full of important facts and fine illustrations regarding tube expanders, pneumatic hammers, beading tools, mandrels and rolls, reversible ratchet wrenches, self-feed tube cutters, and superheater sectional spring tube expanders. Established nearly twenty-five years ago the firm has gradually built up a reputation that is second to none in their specialties. The catalogue has the double quality of not only describing the tools, but the illustrations show how the tools should be used. Locomotive charts of locomotives in use on the chief railroads in the world illumine the pages and make the catalogue one that will likely be preserved. Copies may be had on application.

The Westinghouse Electric & Manufacturing Company has just issued Circular No. 1,505. Results obtained by electrification on some of the important steam railways of the world are included in this circular, giving information of interest and value to steam railroad operators on electrification work. Contained in this publication are well illustrated descriptions of the Norfolk & Western, Pennsylvania, New York, New Haven & Hartford and other electrifications installed by the Westinghouse Company.

Aluminum Coating.

A Japanese invention which coats iron or steel with aluminum has been put into successful operation. The metal to be treated is first galvanized, then it is dipped into a bath of molten aluminum at a temperature varying from 1,100 to 1,200 degs. Fahr. To obtain satisfactory results the metal under treatment must be immersed two or three times. It is claimed that the aluminum coating has wonderfully good adhesive properties and will not wear off through abrasion.

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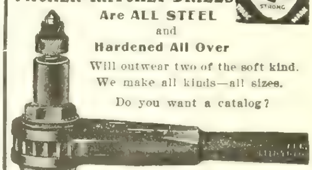
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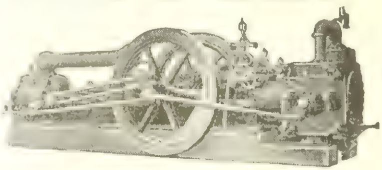
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Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVIII. 114 Liberty Street, New York, October, 1915. No. 10

Continued Improvements on the Santa Fe Railroad

It [illegible] comparisons between the various railroad trains between Chiciago and San Francisco, but the "Santa Fe de Luxe," of the Atchison, Topeka, and Santa Fe, struck us as containing all that is known in elegance and comfort in railroad travel. When the difficult character of the prob-

[illegible]

lems that has been overcome in the run from Chicago to Los Angeles, embracing as it does six separate mountain ranges where the grades are staggering, one concludes that they surely were heroic men that first ventured on such an undertaking. After leaving Chicago the line has a practically level run of 240 miles, to Fort Madison, the maximum grade westward being 31.68 feet per mile. The 200 miles to Kansas City is almost similar in grade except at one point, where there is a rise of 42.24 feet per mile. Kansas City is at an elevation of 750 feet above the sea, but within the next 640 miles the train has [illegible] of the first range at Raton. For the last sixteen miles to this summit the train has to struggle against a rise varying from 106 to 185 feet per mile. Passing Raton, the line drops 1,858 feet, climbs 980, falls again 500 feet, and once more struggles to 7,421 feet at Glorieta, the second summit, these violent fluctuations in level occurring within 200 miles. Then comes another heavy drop of 2,307 feet to Albuquerque in the course of 60 miles, followed immediately by another heavy pull up 2,309 feet in 160 miles to the summit of the Continental Divide. There is a further heavy fall to Winslow of 4,848 feet in the next 160 miles, followed im-[illegible] miles.

The railway falls away from an altitude of 7,300 feet at the Arizona Divide to 578 feet at Needles, the 6,722 difference in level being overcome in 600 miles. After leaving Needles the line rises 1,930 feet in

[illegible] to [illegible] upward pull to Cajon summit at 3,820 feet altitude, involving a climb of 3,209 feet in [illegible]

[illegible] BRANCH OF THE SANTA FE [illegible]

drop of 2,744 feet to San Bernardino, fol- [illegible] to Tehatchapi summit, which is about 50 miles by rail from Cajon summit. For 25 miles the rise through the Cajon pass varies between 116 and 158.4 feet per mile, while there are 25 miles of grade at 116 feet per mile to the Tehatchapi summit.

[illegible] Angeles is 2,263 miles and in 1911 a special train was inaugurated, certainly [illegible] journey in 63 hours, making an average of 36 miles per hour from terminus to terminus. The heavy mountain banks, even with extra motive power of the [illegible] time that on the level stretches the track velocities of 65 and 70 miles an hour are frequently attained.

In passing over the route one cannot fail to be struck with the substantial nature of the construction work of the great railway. Steel bridges, monuments of en- [illegible] granite, come at intervals, while the general equipment is equal to the best of the Eastern railways. Intelligent activity, heightened by the assurance of a revival of industrial growth, is manifest on every hand.

A particularly marked feature of the [illegible] of cordial relations between the employes and officials. One important factor to this end has been the fixed practice of making all official appointments from among men already in the service of the road. When Mr. Ripley was given charge of the property he brought only three or four men with him, and since that time all positions have been filled by promotion from the ranks. While applications for positions are continually received from men on other roads, the invariable reply is that the only way to secure these positions is to enter the ranks and take chances with the employes.

The idea of retaining the proper class of employes has been a problem on all the roads operating in the Southwest. For this reason the Santa Fe has given special attention to the development of a system of reading-rooms at nearly all of the division points over the system, and about twenty-five different terminals are now equipped in this way. One man has supervision of these various reading-rooms with a separate manager in direct charge at each point. The railroad company provides the buildings and their maintenance and operation, spending nearly $90,000 on this last year. It also cooperates in the support of three railroad Y. M. C. A.'s at places not provided with reading-rooms.

A pension system similar to that of several other roads has been in force since 1907, with provision for a minimum monthly payment of $20 and a maximum of $75. On June 30 last 346 employes were carried on this roll. Three seperate hospital associations are maintained by contributions from employes, one on the Eastern and Western lines, one on the Gulf lines and the third on the Coast lines, and company hospitals are located at ten important terminals.

While not by any means confined to the Santa Fe, this road has been a strong advocate of apprentice courses in the mechanical department, adopting the system now in effect for machinist apprentices in 1908. This course covers four years. On November 30, 1914, 549 machinist apprentices were enrolled, while 865 apprentices had been graduated up to that date. A $12,000-building was completed at Shopton, Ia., last year, with classrooms, laboratories, baths, etc., for the use of the apprentice students. A similar course lasting three years has re-

[illegible] RIVER ON THE [illegible] BRANCH OF THE [illegible] RAILROAD

cently been started for carpenter apprentices in the car department at Topeka and Shopton, while it is now planned to inaugurate in the near future a course whereby men may be trained for official positions in the mechanical department.

In less than twenty years the property has been entirely rebuilt and improved, the mileage has increased over 70 per cent., the number of locomotives has increased over 120 per cent. while the tractive power has increased even faster and the number of freight cars has increased 150 per cent. The density of traffic has more than doubled, while the present facilities are ample to handle a considerable further increase in traffic. This has been accomplished by the expenditure of over $298,000,000, for which over $217,000,000 of "new money" has been raised. With all these improvements the capitalization per mile of line has decreased from $61,500 in 1896 to a little less than $57,000 per mile, practically 50 per cent. of which is represented by stock while the fixed charges consume but 11.6 per cent. of the gross revenue. This work has been carried on from year to year without any suggestion of irregularities or criticism of methods of financing or operation, and the great popular favor into which the road has come is the best proof that the traveling public is quick to appreciate enterprise when properly directed. The traffic this year to and from the Panama-Pacific Exposition has far surpassed all expectations.

Much of the daring enterprise and marked success of this great railroad is owing to the courage and sagacity of Mr. E. P. Ripley, the worthy president of the Santa Fe System. His work has been largely in the operating department of several leading railways, but his studious and trained mind has mastered all the engineering problems of railroad work. He is a thoroughly accomplished, all-round railroad man, polished by Eastern education and experience, and broadened by the vastness of Western enterprise.

The road is now operated in twelve States and territories, and there are millions of acres of land and incalculable mineral wealth in those sections of the country that are only idle on account of the lack of transportation facilities. The Santa Fe is ready to make the extensions, but has been met by the legislatures of several

E. P. RIPLEY,
President Santa Fe Railroad.

States in a spirit not calculated to encourage the construction of new branches. The result is of the most pernicious kind. Enterprises of great pith and moment are turned aside and lose the name of action. Mr. Ripley seems confident that some measure of common sense will come back to the legislative bodies in the [illegible] time, but, like the sensible man that he is, he is not praying for miracles.

To one having an eye to scenic marvels, the Santa Fe route has wonders peculiarly its own. Mountains in purple splendor, the silvery flash of lake and stream, the far-spreading, flower-spangled prairie, the ever-changing fantasies in azure, damask, emerald, and gold, are to be seen all over the West, but it is only on the Santa Fe that you can come on that wonder of wonders, the Grand Canyon of the Colorado. Like Niagara, one comes on the awful scene unexpectedly. The country is slightly undulating, and suddenly you are on the brink of a dread abyss, and the appalled vision is presented with a spectacle of natural grandeur at once beautiful but terrible. The cleft in the earth is a mile deep and nearly fifteen miles wide. As you look across the great gorge the stupendous magnificence of the scene seems to grow beyond the reach of human vision. The jutting caps and storied towers and pinnacled castles cluster confusedly. Lengthwise, the amazing scene seems stretching into infinitude. Far as the eye can reach are precipitous crags upon crags. The rifted rocks, rainbow-hued, show layers of green and red, russet, blue, orange and alabaster. Beneath are gloomy forests, through which the Colorado river foams and flashes. To explore the myriad recesses of this marvellous mystery of nature seems utterly beyond human endeavor, and, like a lurid lightning flash, one brief glance at this overwhelming panorama of color and grandeur, and it has burned itself into the memory forever.

Mechanical Stokers.

No device ever applied to a locomotive has made such rapid progress into popular favor as the mechanical stoker. In the early days of the application of the mechanical stoker, some people persistently circulated the assertion that the success of the mechanical stoker would [illegible] borers to do the work of operating the stokers. Senseless as was this idea it made many converts and the introduction of mechanical stokers was opposed by firemen on some railroads, or the device given such half-hearted attention that it proved less than a success. There is a much better spirit displayed among the enginemen now-a-days.

[illegible] TRAIN ON THE SANTA FE [illegible]

Braking Power and Foundation Brake Gear

By WALTER V. TURNER, Acting Vice-President, Westinghouse Air Brake Co.

Without a Properly Designed Foundation Brake Gear the Most Efficient Brake Gear Mechanism Is of Little Value

In reply to your letter containing a request for information on the subject of foundation brake gear for passenger cars and the correct per cent. of braking ratio to be employed, the same to be used for publication in your magazine, you will agree with me that this is entirely too broad a proposition to be dealt with in a limited space or in a very short time. However it may be possible to make this subject somewhat more comprehensive to the air brake man if the matter is taken up in different stages and at the outset it may be well to state that whatever I may have to say at the present time is to be regarded as merely a preliminary to a subject that in itself is intricate enough so that one fully comprehending all its essentials and details could write several volumes without exhausting the source of information; in fact, during such a process the author would quite likely encounter several phases of air brake performance that if regarded from a generally accepted viewpoint, are apparently inexplicable.

Before giving this subject the serious thought required for an analysis of certain brake performances, I may be pardoned for stating that I also considered the effectiveness of the air brake to depend mainly upon the operation of the air actuated devices and the foundation brake gear to be of secondary importance, but I have since come to the conclusion that this might well be reversed, that is, without an efficient and properly designed foundation brake gear, the very highest developed [illegible] mechanism is of little value; the fact of the matter is, it is better to use inferior and less powerful air brake valve mechanisms with poorly designed and improperly proportioned [illegible] than to use efficient brake mechanisms in such cases.

Some time ago in speaking before a railroad association, I had occasion to state that the brake which can transform the fluid pressure of compressed air into [illegible] tion brake gear adequate for the development of this force, and, if it is not provided, distortions, shifting of wheels, binding of the wheels in the pedestals, unequal divisions of the force to the wheels, in fact, every conceivable undesirable condi- [illegible] present scope of railroading possible, namely the air brake.

[illegible] ratio problem and of inadequate and damaging designs of foundation brake gear are not apparent in themselves; that is to say, the foundation brake gear is a dormant appendage in itself until the air actuated mechanism cause it to come into action, and since whatever damage or ill effects result, must have been caused by the air valves themselves inasmuch as everything was all right until they were called upon to perform. This is as logical as blaming a train for being wrecked by a broken rail, for obviously the broken rail would not have mattered had the train not come along; or blame the blowing up of a boiler on the steam that caused it, since the boiler could not have blown up had there been no steam present, but in this case most men of sense blame it either upon improper design or maintenance of the boiler, and I have hope that some day the same line of reasoning will be applied to the two interdependent and intimately related parts of the air brake, namely, the air actuated devices and the foundation brake gear through which is transformed the air pressure into a mechanical force and then transmitted through the shoe to the wheel.

Before the commencement of the air brake tests in Toledo in 1909, I made something of an analysis of the braking situation and potential, the working out of which has resulted in some very desirable and profitable improvements, but at Toledo and subsequently in the installations of air brake mechanisms capable of developing great forces, it was apparent that the foundation brake gear was very inefficient in transmitting the air pressure to the shoe on one hand, and that due to distortions, binding of wheels, [illegible] truck frame into a suspension beam for the wheels, very unequal braking force producing surges and wheel sliding could occur.

At the time of these tests we had every reason to believe that with the air brake mechanism but recently designed at that time, that a stop could be made with the braking ratio to be employed in 1,200 ft. from a 60-mile per hour speed on a level track, but somewhat to our surprise it required something like 1,450 ft., and in pondering over the cause of the discrepancy in the figures I finally concluded that along with the use of improper and inefficient design of foundation brake gear, there were four other factors that contributed largely to the lengthening of the stop beyond that anticipated. These [illegible] coefficient of friction of the brake shoe, due to the higher forces developed, the greater mass of the locomotive which was unbraked, the larger brake cylinder volume without proportional provision for getting the air into the brake cylinder quickly, and the increased length of time in which to get the brakes started to apply throughout the train, due to longer cars, which means greater brake pipe volume to be exhausted without adequate provision being made in increased number or efficiency of quick-action venting devices for the purpose.

To just what extent each of the losses enumerated affects the distance in which a train of cars can be stopped by the air brake is now positively known, in fact, it can, through the advancement of the air brake art, be calculated down to the inch in distance or to the pound in force developed, and it has been amply and conclusively proven during and since the air brake tests conducted on the Pennsylvania Railroad at Absecon, N. J., that not only has this been confirmed, but any modification in any one of these factors in any considerable degree evidences itself by such a wide margin in air brake performance that any violation of the principles involved, or rather of those particularly mentioned will result in inefficiency and loss.

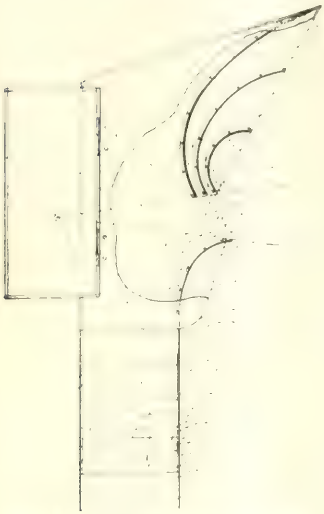
Now we know that it costs money to properly construct trucks and foundation brake gear to say nothing of changes necessary in present equipment in service, however, money intelligently spent as it would be in such a case, will bring returns that will more than compensate for the expenditure. It may also be exceedingly difficult to make such matters clear to a large proportion of humanity, but among the smallest influences of progress and development are those people who do not possess a proper sense of proportion between great and small. This is, however, a frailty of human nature, for a man may be concerned only with that which immediately concerns him, and if his particular duty is concerned with keeping down troubles he is apt to magnify these, losing sight entirely of the greater gains and benefits that may be derived by eliminating every shortcoming.

In a future article this subject of foundation brake gear will be continued, but recommendations as to any braking ratio to be employed will be avoided until such time as the interested reader has been afforded an opportunity to understand the reasons for the recommendations.

Lookout Double Deflector Shield for Locomotives

By E. J. McMILLAN, Moose Jaw, Sask., Canada

The need of better protection for the eyesight in running a locomotive is a great and growing necessity, and while I have had much personal experience



[illegible]

in the severe Canadian winters it happened some time ago that an engineer named Corbett appeared before a coroner's jury in Moose Jaw, charged with negligence, in that he ran his train almost full speed into the rear of a freight train in the Pasqua yards, killing and mutilating two ranchers who were in the van of the standing train.

As the stories of the engineer and crew, who had miraculous escapes, were told and repeated, the jury was more and more impressed with the hopeless fact that the only absolutely true verdict would be against the conditions, which seemed to be unavoidable unless all trains were to be [illegible] in very bitter weather.

Evidence was offered, sworn to and reaffirmed, without challenge, that under the conditions such as Engineer Corbett was working he had not even a reasonable chance of security without stopping his train. A dark night, forty odd below zero, a head wind of thirty or more miles an hour, which combined with his own velocity made a total of a fifty mile wind to face, and cab windows frozen thickly with ice. A physical impossibility to face even for that small fraction of a second necessary to register an impression on the retina of the eye, and even the attempt to do so involves the necessity of several minutes to recover from the torture of contact with weather too bitter for human [illegible] to anticipate.

Moreover, engineer after engineer faced the jury, and testified that these conditions were frequent in winter; that they were often compelled to run almost their whole division with never one satisfactory view of the track while in rapid motion.

Here one sees the outline of the conditions, and, what was most striking to the jury, not one word of rebuttal was put in by the railroad company or officers of law; not one word or sign of animus was shown by them to the unfortunate engineer; no effort was made to prosecute him at any stage; thus they proved eloquently by silence that they believed the condition to be inevitably bad, and the man more the victim than the culprit.

The device of single deflection was called into use some years ago, and partially solved the difficulty, but the system of double deflection which I have discovered, has solved the problem from an entirely new angle. The device utilizes the principle of double deflection, that is, pressure at one and suction at the other side of the necessary line of vision, using these forces of the air currents generated by the motion of fast moving vehicles, to gap across sufficient space through which the lookout man may receive full protection to his eyes and yet look right into the teeth of any wind, storm or cold with no glass or any other protection other than the use of double deflection which has resulted in the gratification of showing that the device has not only [illegible] hundred per cent. of efficiency, but a margin of effectiveness for any extreme contingency of bad weather conditions, including a soft snow fall, which is the most severe test to which the mask can be subjected.

In a short time the device has received the commendation of all of the railroad and Brotherhood officials who have had the opportunity of observing its operation, and has already been officially adopted by the Canadian Railway Mail Service.

The operation of the mask against the wind is such that a slight current of air flows away from the eyes into the shield and will carry a piece of cotton waste off the hand into the middle of the deflector. It is a practical "safety first" invention, and not only saves the eyes from the effects of incoming wind, but also stops the current of smoke and cinders that comes from the ash pan when a cross wind is blowing from the opposite side of the engine, and also has the quality of having the vision entirely open.

The accompanying illustrations afford views of the device in position. Patents have been already secured in Canada and it is being adopted by the Canadian roads through the Brotherhood of Locomotive Engineers, and each of the Provincial Brotherhoods have in their care a regular working model of the mask, testing it under the varying weather conditions, and all opinions agree as to its usefulness and efficiency.

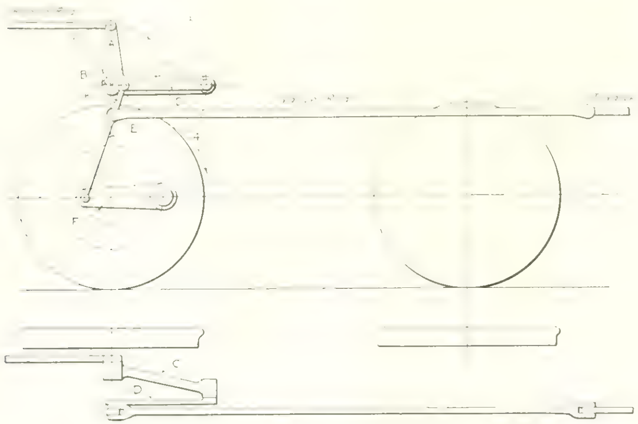
In conclusion it may be stated authoritatively that under normal conditions the eyes absorb 25 to 30 per cent. of the nervous energy generated by the human body, and in a way, dominate the situation and uses the energy to meet the strains as they come, and when unusually taxed have a very depressing effect on the other parts of the body that under [illegible] their usual supply of energy, so that no [illegible]

[illegible]

The O. K. Locomotive Valve Gear

By R. W. ROGERS, M. E. Apprentice Instructor, Port Jervis, N. Y.

Designed and In Operation In Germany



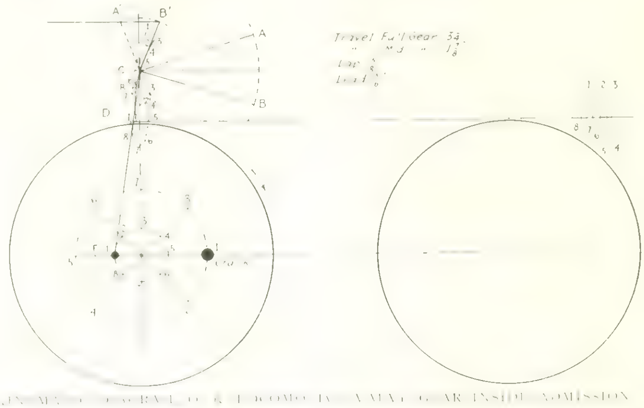
THE O. K. LOCOMOTIVE VALVE GEAR INSIDE ADMISSION

The trouble with most radial valve gears such as the Joy and Marshall and modifications of the latter type of gear such as some in use is the inherent error due to the springing of the frames and angularity of the connecting rod.

The gear shown in the sketches designated as the O. K. Locomotive Valve Gear, has been used by a firm in Germany with good results in overcoming these troubles.

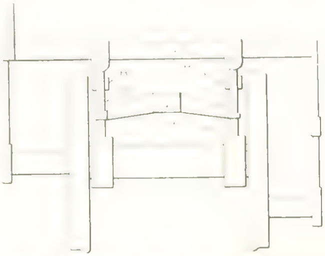
The general design of the gear is similar to the Marshall gear, the motion of the valve being derived from two sources, namely, the return crank F and a point on radius rod "D" swung about in arc 3-4. "E" is the floating lever or eccentric rod, to which is joined the valve rod and then the valve stem leading to the valve. The reversal of motion of the locomo- [illegible] operated by means of reach rod points 1 and 3 are relative position for backward [illegible] motion. The center of return crank is located 180° to rear of crank pin. The reverse shaft B connects both to sides of the locomotive, as in ordinary construction, but [illegible] driving boxes by means of rods "G-G" so [illegible] rods are guided by thimbles H H connected to frame and kept in proper tension by spring "J."

[illegible] sired lap or lead by proportioning the [illegible] centric according to well known principle E : K :: Diameter of Return crank [illegible] of the gear showing the well known valve [illegible] lead and 3½ in. travel full gear, a good distribution of the steam. Any desired cut off can be obtained by changing the lap as desired.



KINEMATIC DIAGRAM OF O. K. LOCOMOTIVE VALVE GEAR INSIDE ADMISSION

The sketch shows the [illegible] gear. The possibilities of this gear for



[illegible] are self evident [illegible] shown for outside admission either a rocker is placed between valve rod and valve stem or connection of valve rod is made above radius rod "D" or extending lover "E."

The angularity connecting is practically confined to middle of valve stroke and is easily taken care of. The simplicity of the valve as to the number of parts and operation is self-evident and the elimination of the influence of the spring play should make this gear quite of general use. It is covered by a patent in Germany and it is believed to be patented in other countries also.

The Kinematic Diagram shows the analysis of the forward motion of the gear, the numbers indicating the corresponding positions of crank, return crank E, poin "D" of valve rod connection to floating lever or eccentric and point "C" of radius rod as well as motion of valve. It is evident that the valve is quite rapid in its movement on dead centers thus insuring a lively valve action. The lead is constant. B¹ B are positions of reverse bill crank arms for forward motion and A¹ A the position for backward motion.

The length of the various arms can be adjusted to suit any condition desired. It will also be observed at a glance that the parts are few in number, and the weight of the gearing is lighter than any other kind of valve gear used on locomotives. Its adoption would lessen to a considerable extent the cost of valve gears on the modern locomotive, which is a growing item in the original as well as in the maintenance cost, which with a number of parts and bearings are constantly in need of repair. The reports from Germany, in regard to the gear, although somewhat meagre, are of the most encouraging kind, and it seems is if its general use there is already foreshadowed.

Air Brake Testing Device

By J. A. JESSON, Louisville & Nashville Railway, Corbin, Ky.

The enclosed illustrations show a convenient testing device for attaching to the hose couplings on the rear of locomotive tenders.

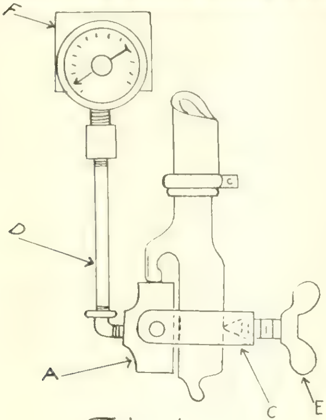


Fig. 1.

The construction of the device renders it available for either connecting to the air brake or signal hose couplings and by means of the hook "F" it can be suspended from the grab iron.

"A" is a piece of turned brass with a bold face having a boss which fits in the hose gasket, the opposite face is tapped for a ¼-inch pipe fitting. A hole is drilled through from one periphery to the other which connects with the holes leading to the hose coupling and pipe fitting. Each terminal of this hole is tapped for ¼-inch test cocks "B, B." These cocks (Fig. 2) serve the purpose of hinging yoke "C" to casting "A" as well as being used for test cocks. One is choked for signal test and the other for feed valve test. A ¼-inch pipe "D" connects the casting "A" to the gauge. Yoke "C" is tapped for thumb screw "E," its inner end is drawn out to a sharp center point. Fig. 2 shows the device attached to a hose coupling. The [illegible] the coupling sufficient to prevent slipping.

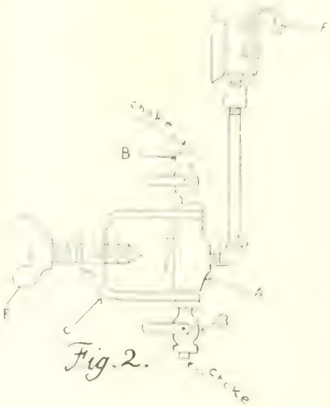


Fig. 2.

Bridge Repairs on the Duluth, South Shore & Atlantic Railway

By J. G. KOPPEL,

Electrical Superintendent of Bridges, Sault Ste. Marie, Ontario

On the Duluth, South Shore & Atlantic Railway draw-bridge at Soo, Michigan, the bridge being a relic of many years standing, but has given excellent service, it was quite recently discovered, however, that the bridge showed a slight tilting on one side as trains were passing over. This was more particularly observed on the northern end where there is a slight curve.

On close investigation it was found that the foot-spindle nuts were badly worn, so much so that the threads did not hold with that degree of tightness essential to security. The nuts on the spindle are of brass, and weigh about 55 pounds each, and the cost of new nuts would have been considerable, not speaking of the difficulty of making a perfect fit on the partially worn threads of the spindle.

The accompanying drawing shows how the difficulty was overcome by reboring and bushing the nuts with a sufficient degree of tightness, and after threading the nuts in order to perfectly secure them in place against future tendency to loosen, accommodation for two set screws were tapped and adjustable headed set screws were inserted as shown. The job was completed in a very short time, and the results are of the most satisfactory kind.

Need of Improvement in Roundhouses

By WILLIAM McINTOSH

While some recently built roundhouses show improved facilities, the larger majority throughout the country, especially in the East, are sadly deficient in modern conveniences, and in many instances are conspicuous by their absence. No doubt there is more than one manager disappointed at the returns obtained from modern roundhouses and large equipment, by its performance on the road and the time required to turn it into service again at terminals; and the question might be raised—whether even better results might not be obtained by allowing the locomotives a longer lay over, and making greater efforts to keep them keyed up.

The efforts in recent years, to show abnormal results on the ton mile basis, leads to some slow train movements, which are often credited to the inability to turn engines rapidly enough at the end of the run. It frequently occurs that trains bunch and follow one another into

[illegible] that would swamp the [illegible] and requires [illegible] The spasmodic [illegible] effort to clean up is a great deal [illegible] holding men and engines on the road when they should receive attention in the way of patching up. The personal efforts of superintendents and master mechanics in such cases might be considered of doubtful value, and more [illegible] during the week.

Let us advertise for a roundhouse foreman. He must not be either too old nor too young. Must have a good education and a thorough knowledge of handling and repairing locomotives.

Must know how to handle men successfully. Be diplomatic enough to keep on good terms with the yard master, train masters, train despatchers and others. Must be of a cheerful disposition—optimist preferred. Will not object to being [illegible] 52 Sundays and 300 nights each year.

Must not be affected by climatic changes and willing to transact business out of doors in the absence of shelter. Who, like "Mark Tapley," must be cheerful under adverse conditions. He must answer the train despatcher pleasantly when he cannot furnish an engine that has not arrived; explain how long it will take [illegible] in the 90 and [illegible] and what's to do with the 001. He must not murmur when obliged to pull one engine apart to repair another, while awaiting the convenience of the storekeeper and purchasing agent to bring up supplies; and he [illegible] always have a few engines up his sleeve to meet emergencies. A regular job and steady employment awaits the successful applicant.

Seriously, the roundhouse foreman [illegible] fellow, well balanced, and preferably with both shop and road experience. To be successful, he [illegible] the unqualified support of his superior officers. Such a man will make his way under any circumstances, but will do better [illegible]

[illegible]

Design and Construction of the Modern Locomotive

By J. SNOWDEN BELL, New York

[illegible] cyclopedia to be correctly informed as to subjects with which we are either unfamiliar or desire to know more thoroughly. Such a work is, of course, essentially educational, and, in that re- [illegible] by erroneous statements of fact, but it is also rendered positively misleading and [illegible] from an article entitled "Design and Construction of the Modern Locomotive," appearing in Vol. XII of "The Americana," New York, 1911.

After referring to the suggestion of applying boilers to the "water tube" type in locomotives, the author says: "The principal difficulty of applying a boiler of this type to a locomotive lies in the circumstance that *the shell of the ordinary [illegible] serves as a part of the framework of the locomotive*, and as it is not much heavier than the best water tube boiler of the same capacity, *it is impossible to [illegible] it without materially increasing the weight of the frame*."

The statements that I have italicized are, as will be recognized by any one who understands the design and construction of the modern locomotive, completely at variance with the facts, and to the last degree misleading as to a fundamental principle of locomotive construction. The shell of the boiler is no more a part of the framework of the locomotive than is the sand box or the head light, and the restriction of its duty to the capacity of safely resisting the pressure of the steam within it, and its complete relief from all other strains, particularly those which would result from making it a part of the framework of the locomotive, are matters so obviously necessary to correct design and effective performance, that the compliance with these requirements which has been made in all "modern" locomotives, is merely ordinary common sense, which no competent designer has failed to exercise.

As early as 1863, a single type of American locomotives, the "Camel" engines of Ross Winans, which was not built after 1860, was found to be defective in the particular that the draw bar was connected to the boiler, which, for that reason, became "a part of the framework of the locomotive." This defect in design of these ancient locomotives was, to the personal knowledge of the writer, corrected by connecting the draw bar to the frame, and if there has been an instance of its repetition in any "modern" locomotive, which is to the last degree improbable, the record of such objectionable and dangerous practice would be enlightening.

The statement of the Americana article that a water tube boiler could not be substituted for a boiler of ordinary type "without materially increasing the weight of the frame" is so palpably unfounded and absurd that argument in reply to it would be needless.

While the complete accuracy of a text book, as to more matters of detail, cannot reasonably be demanded in a work of the character of that in which the foregoing quoted statements appear, it should at least be substantially correct as to facts relating to the leading and characteristic features of the subject matter which it purports to describe.

Mechanical and Scientific Notes

Boring Lead.

Lead can readily be bored with an ordinary auger, if it is large enough for the size of the holes required. Lubricate with plenty of tallow, or soap and water. Too much weight should not be placed on the auger, and it should be taken out frequently to remove the lead shavings.

Drilling Hardened Steel.

Holes may be drilled in tempered steel, such as circular saws, springs, music wire, etc., by hardening an ordinary twist drill in sulphuric acid. The pure acid should be placed in a saucer or other flat-bottomed vessel to a depth of about 1/8 inch. The point of the drill is heated and dipped in the acid to that depth, making the point extremely hard, while the remainder remains soft. If the point should break, reharden as before, but have a little less acid in the vessel. In this manner the drill may be hardened just enough to drill the steel, but not brittle enough to break when coming through.

Cleaning and Oiling Belts.

Belts which have become too greasy and dirty should be cleaned with gasolene, then scraped and wiped with waste. In dry, dusty places it is well to brush them occasionally with a broom or stiff brush. No rosin or belt dope should be used except fish oil and tallow mixed in equal parts. Apply hot with a brush when the belt is running, or dip the belt in the dope tank, then dry and wipe off any grease, which may have hardened on the belt. If applied while running, care should be taken not to get too much on the belt, or it will cause it to slip. No mineral oil should be allowed to come in contact with belts. New belts should be treated with fish oil and tallow before using, and any belt which becomes dry, hard and glossy in service should have an application of the dressing. This is especially true of belts in blacksmith shops. The oil will check to some extent the evil effects of the smoke, sulphur gases and dirt, and the life of the belt will thereby be lengthened.

Cement for Steam-Pipes.

Grind and wash in clean cold water 15 parts of chalk and 50 parts of graphite. Mix the two together thoroughly and allow to dry. When dry, regrind to a fine powder, to which add 20 parts of ground litharge and mix to a stiff paste with 15 parts of boiled linseed oil. The preparation may be set aside for future use, as it will remain plastic for a long time if placed in a cool place. It is applied to the joint packing as any ordinary cement, and will be found to last a very long time.

Twenty-third Annual Convention of the Traveling Engineers' Association

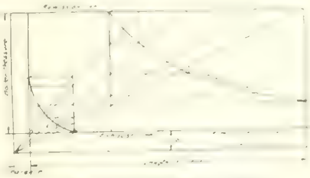
The Traveling Engineers' Association held its twenty-third annual convention in Chicago September 7-10. Mr. J. C. Petty presided, and opened the proceedings with an excellent address in which he urged a closer relationship of the members of the association with all of the other railway departments. Mr. C. H. Markham, president of the Illinois Central, paid a high tribute to the members and spoke at some length on the unfair legislation that had hindered railroad progress in the past. He deprecated strikes as leading towards government ownership with all its disastrous results. Mr. F. W. Brazier, superintendent of rolling stock, New York Central Lines east of Buffalo, spoke eloquently of the importance and development of the modern locomotive and the opportunities for advancement for those who mastered its details. Mr. Frank McManamy, chief inspector of locomotive boilers, presented some interesting statistics in regard to the operation of the boiler inspection law, and pointed with pride to the fact that accidents to boilers causing injury had been reduced 51 per cent., and fatal casualties had been reduced 86 per cent., and injuries 54 per cent. He declared that the results of the work of the Interstate Commerce Commission was of the most beneficial kind, and only required to be known to be warmly appreciated and loyally sustained.

In the course of the meeting Mr. Warren S. Stone, grand chief of the Brotherhood of Locomotive Engineers, also spoke of the importance of the traveling engineer as the intermediary between the engineers and the railway officials. The fact that some railroads were getting better service from the enginemen than others simply showed that there was a greater degree of confidence existing between them. Mr. Stone closed by urging the traveling engineers to set up a high ideal of honesty and square dealing and to "hew to the line and let the chips fall where they may." Mr. Stone was afterwards elected an honorary member of the Association.

The Committee Reports and Papers were of more than usual interest and showed a thoroughness that can only come to men who have mastered the subjects treated of by long and active experience. The following condensed reports of the papers presented will bear out such observations. The discussions were also full of interesting experiences, and will be published in full in the annual volume issued by the Secretary of the Association.

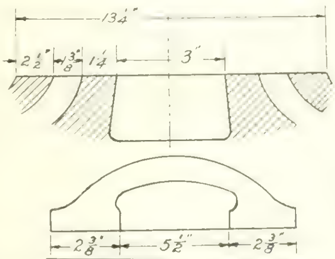
THE EFFECT OF [illegible] VALVE GEAR ON [illegible]

Mr. W. E. Preston presented a report extending to thirty-six pages on the above subject. The document showed how



IDEAL INDICATOR CARD

thoroughly he had conned his subject. Beginning with the ideal indicator card he pointed out the defects in valve gears by the exhibition of indicator cards taken in actual practice. In referring to new devices which are constantly coming into trial it was clearly shown that no de-



DIAGRAMMATIC SKETCH OF PRINCIPAL DIMENSIONS OF VALVE AND PARTS

vice which seeks to improve the steam distribution in a locomotive can succeed which does not save steam when compared with devices previously in use. In proportion as it saves steam it both increases the efficiency of the engines and increases their maximum power, for since

INDICATOR CARD WITH [illegible] SHOWING WHERE [illegible]

[illegible] steam saved is a pound of steam available for additional services.

From the performance of a simple locomotive having a normal valve gear with its narrow port openings and wire-drawing effects, we may turn to the Corliss engine, the action of which is generally accepted by all improvers of locomotive valve gears as a standard of perfection. Such an engine, with its large port openings and its prompt movement of the valves, can, in fact, be relied upon to give as good a performance as engines having any other type of valve gear operating under similar conditions of speed and pressure. Corliss engines, having cylinders which are comparable in size with those of locomotives, and which work under a similar range of pressure, are, however, not common, and hence it is not easy to command data for the proposed comparison.

Straining the facts applying to the two classes of engines as widely apart as a knowledge of existing data will possibly permit, we may assume that a Corliss engine, if given the advantage of the high steam pressure and high piston speed common in locomotive service, may give a horsepower hour on the consumption of two pounds less of steam, or approximately 8 per cent. less than the locomotive. This, then, is the margin upon which those who seek to improve the locomotive valve gear must expect to work. While it is well worth attention, it cannot revolutionize practice.

Hence real and lasting improvement, is to be looked for more along mechanical lines than in attempts to improve the character of the motion imparted to the valve. While there is a chance for slight saving in fuel, the real economy which may result from the adoption of a better gear is to be found in its lower maintenance cost, and in the greater certainty of its action. What is most desired in a valve gear is a mechanism, which, under the adverse conditions of actual locomotive service will give to the valve that precision of movement it is designed to have. Along these lines there is ample opportunity to improve present practice.

[illegible] REPAIRS.

Mr. Martin Whelan, chairman of the committee on the above subject, presented a report, and it was clearly pointed that, although many locomotives had been changed from coal burners to oil fuel burners, the presence of smoke is as objectionable and as expensive in the one case as the other. Stationary plants on the other hand using oil fuel were generally free from smoke. They had larger furnaces and a natural draught, while

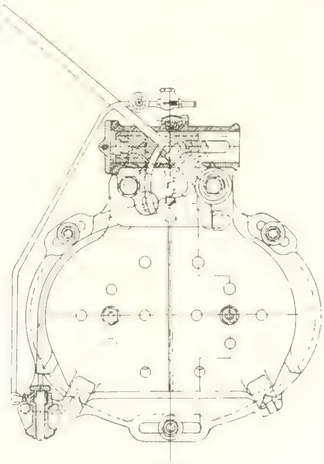
the locomotive [illegible] furnaces and [illegible] draught [illegible] cause of smoke is always [illegible]. On the oil burning locomotive the loss of fuel is much greater than with coal. The formation of carbon in the firebox causes much smoke and wastes much fuel. Carbon is formed by allowing the oil spray to strike some object in its path before it reaches the draught holes. The engine crew possessing a general knowledge of the principles of oil combustion can, by close attention to their duties, do much to prevent smoke formation. If the engines are kept in the best possible conditions much can be accomplished that is worthy of notice. The report concluded by stating that it will be readily understood that black smoke and the cost of fuel and repairs are closely related to each other on the oil-burning locomotive, and any practice or device that will reduce or eliminate smoke will result in a great saving for the railroads.

RECOMMENDED PRACTICES FOR THE EMPLOYMENT AND TRAINING OF NEW MEN FOR FIREMEN.

The Committee on the above subject of which Mr. L. R. Pyle was chairman presented a lengthy report setting forth the weaknesses of the present haphazard methods of employing and training firemen, and dwelt on the lack of interest shown by the railroad officials on the subject and the consequent lack of inter- [illegible] in the [illegible]. The Committee [illegible] should have charge of the hiring and training of firemen. The applicants should be carefully chosen, and after a short time any man who does not come [illegible] should be weeded [illegible] systematic effort on the part of every railway to educate and develop the men who are employed as new firemen, so that when they start firing they have a clear idea [illegible] first [illegible] be given a position about the roundhouse [illegible] machinist helper, or on the cinder-pit. If there are shops near or at the terminal, new men can be placed there. They will thus get experience which will be of much value to them, after they get on the road as firemen and even after they are engineers. At first they should make a few student trips with picked crews. With some instructions in the chemistry of combustion, they will develop into firemen at once instead of taking months and years as is now the practice. Men of this kind would make the officials look to themselves and see where they stand, [illegible] along to keep up with the young firemen. [illegible]

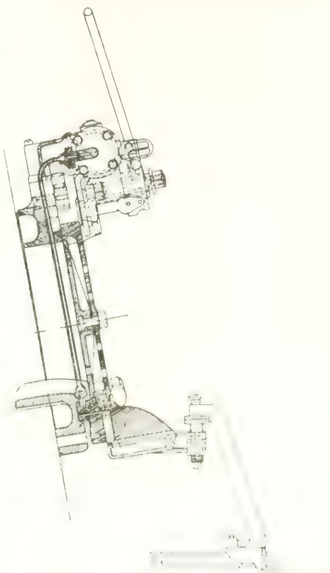
ADVANTAGES OF SUPERHEATERS, BRICK ARCHES AND OTHER MODERN APPLIANCES, ON LARGE LOCOMOTIVES, ESPECIALLY THOSE OF THE MALLET TYPE.

Mr. J. E. Ingling, chairman, and an able committee presented an exhaustive and



AUTOMATIC FIRE DOOR.

interesting report on the above subjects. In reference to superheating locomotives an excellent illustration was given of two



[illegible]

heated. At the rate of sixteen miles an hour, engine 1625 developed 590 draw-bar horse-power and showed a rapid decrease after sixteen miles an hour, while engine 1654 at sixteen miles an hour developed 750 tons draw-bar horse-power and showed a decided increase up to twenty-four miles an hour and remained nearly constant up to thirty miles an hour. This was due to reducing the rate at which the engine drew steam from the boiler. Increasing the boiler capacity by superheating permitted a longer cut-off with a given throttle on engine 1654. The elimination of cylinder condensation and the high temperature of the superheated steam make it possible to operate locomotive boilers at lower pressures, than is practical with saturated steam, thereby increasing the life of the boiler. Taking the modern locomotive with all its deficiencies the superheater designer has been able to produce an economy of 25 per cent. in fuel, as a direct result of saving one-third of the total water evaporated per unit of power developed.

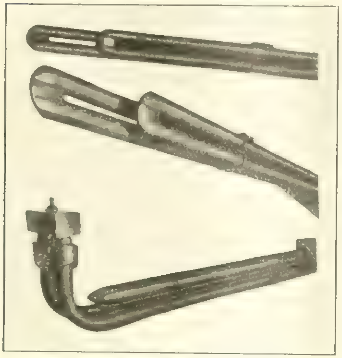
In the difficult problem of lubrication at high temperatures the most successful solution has been accomplished by the use of high-grade oil, or what is known as superheater oil, and the installation of the lubricator, and pipes and connections with inside diameters as recommended by the manufacturers.

The electrical pyrometer or temperature indicator, indicating the actual temperature in the steam chest, is considered of great and growing importance in superheating locomotives. When the pyrometer fails to read from 600 to 650 degrees, it is an indication that the locomotive is not being properly handled, or that the water in the boiler is too high, or the fire may not be in the proper condition, or a portion of the superheated flues may be stopped up, or there may be leaks in the front end, or the damper may not be operating properly.

Referring to grates, while the Committee did not recommend any particular design, they laid emphasis on the necessity of at least 40 per cent. of air opening in the grates, and that stoker-fired engines required grates with smaller openings than hand-fired engines, due to the fire being carried lighter and difference in size and grade of coal burned. The mechanical grate shaker was recommended as of great assistance to the firemen in keeping the fire clean, and in getting sufficient air through the grates, and as saving excessive physical exertion. Regarding drifting valves the Committee were of opinion that while there were several types of drifting valves in operation, there has not been one developed which will open automatically when the throttle is closed and engine drifting, and automatically close when the engine stops, regardless of position of reverse lever. Unless a drifting valve will close automatically when the locomotive stops it [illegible]

The brick arch, increasing the boiler

capacity directly by aiding combustion, and by reducing heat losses was strongly recommended, and the arch tubes which support the brick add valuable heating surface and increase the circulation of water through the boiler. When burn-



IMPROVED SUPERHEATER PIPES

ing 100 pounds of coal per hour per square foot of grate area, an increased efficiency of 10 per cent. is easily reached by the use of the brick arch.

oiler is from 15,000 to 25,000 miles, and with oiler from 60,000 to 84,000 miles. These figures speak loudly for themselves, not speaking of a corresponding saving of the rails, and also a continuous aid in preventing derailments. The kind of oil that showed the best results contains from 40 to 60 per cent. of asphaltum, and low in grease and paraffine.

Regarding locomotive stokers when worked to their capacity, a more uniform fire-box temperature and correspondingly less flue and fire-box trouble is experienced, owing to the elimination of contraction and expansion on account of uneven temperature in flue and fire-box sheets. The time required for hostling the engine is much reduced. Not only so but the fireman is able to follow his engine more regularly, and is better satisfied, and during the summer months the relief is of a kind that has to be felt to be properly appreciated. Of the merits of the types of stoker opinions were divided, but there are now 593 of the Street stoker in service, 301 of the Crawford type, 28 Standard, 18 Hanna, and one each of the Gee, Ayers and Kincaid. The Street is of the overhead or scatter feed type, while the Crawford is of the underfed type.

weight of the car in tons. In other words, the resistance of a heavily loaded car weighing three times as much as, let us say, an empty car, on a straight and level track is not three times as great as the resistance of this empty car. It is more nearly only two times as great. For this reason an engine can haul more tonnage in heavily loaded cars than in light or empty cars.

The internal resistance for a fifteen-ton empty car at ten miles per hour is 8.19 pounds per ton, or a total of 122.85 pounds per car. The resistance per ton of a car having a gross weight of seventy-five tons is 3.18 pounds, or a total of 238.5 pounds per car. Although the seventy-five-ton car weighs five times as much as the fifteen-ton car, its internal resistance is only about two times as great, a very important fact to recognize.

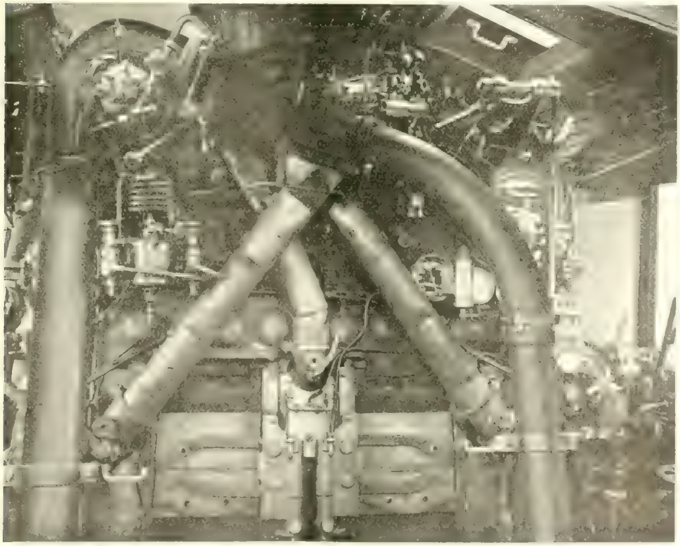
The grade resistance of freight cars is the same as that of locomotives, equalling per ton of car 20 times the per cent. of grade.

Curve resistance also is determined the same as curve resistance for locomotives. For purposes of tonnage rating under average conditions, an allowance of one pound resistance per ton of car for each degree of curvature has been found very nearly correct.

Wind resistance to freight cars is a variable quantity under usual railway operating conditions. Its effect is best determined as a matter of judgment in the use of the various classes of ratings established according to the actual conditions existing. For instance, on a windy day it would not be policy to rate trains as heavy as on a calm day.

External resistance is not affected by weather or temperature and does not vary practically except in direct proportion to the weight of the train. The length of the train, i. e., the number of cars, has little to do with curve resistance and wind resistance, but this influence on the whole resistance is too remote to be determined accurately.

When establishing an Adjusted Tonnage Rating System, the valuable assistance possible from the local division officers should always be sought. Through long experience and intimate contact with the conditions existing on their division they are always able to give excellent advice in regard to many things having an important bearing on this matter.



INTERIOR VIEW OF CAB OF [illegible] ARTICULATED [illegible] RAILROAD SHOWING [illegible]

The flange oiler received very favorable notice from the Committee, their investigations showing that in freight service the mileage a locomotive will make between turning of tires for flange wear without a flange oiler will average from 9,000 to 12,000 miles, with oiler from 25,000 to 42,000 miles. In the case of passenger service the average without

[illegible] RATING.

Mr. O. S. Reyer, jr., contributed a paper on the above subject containing much valuable data. Among the interesting facts it was pointed out that the internal resistance of a freight train, or, more simply speaking of a freight car, does not vary directly in proportion to the

[illegible]

This important question was answered with a degree of fulness that left little to be desired by the Committee of which Mr. C. M. Kidd, was chairman. The report clearly emphasized the fact that the

[illegible] of enginemen in the inspection of their engines [illegible] of failure, can render the most valuable service. Oftentimes the engineer does not know what to look for, or fully appreciate the significance of pointing out to the shop people more clearly than anything else, those parts in the air brake equipment, as well as in the valve motion and the [illegible] developed defects, and which conditions can be best and perhaps only observed while the engine is in service and under steam.

The closest observation and study on the part of the Road Foreman of Engines to keep familiar with the locomotive and particularly with the air brake, should in a sense consider himself a representative of the General Air Brake Instructor while on the road, and in the performance of his duties instruct the enginemen and operate the trains for their benefit.

It was recommended that the Road Foreman of engines regard the instruction [illegible] part of his "work shop," and take every opportunity to completely master the subjects that are therein offered for study, in such a [illegible] to explain the [illegible] to the men on the road, illustrating to them what is possible and how it can best be accomplished.

Electro-Pneumatic Brake.

An illustrated lecture on the electro-pneumatic brake was delivered by Mr. Walter V. Turner, assistant manager of the Westinghouse Air Brake Company. After referring to the important relation of the air brake to the modern locomotive, and its continued improvement in controlling the heaviest kind of trains, he dwelt on the need of a constant piston travel throughout the entire length of the train in order to avoid what is known as "rough handling." Repeated tests had shown that an 8-pound reduction at the end of two seconds with an 8-inch piston travel had developed a braking power of 16 per cent., while cars equipped with appliances furnishing a 6-inch travel of the piston, developed a braking power of 43 per cent., which has a very disturbing influence in the handling of the train. In regard to what is known as the clasp brake, Mr. Turner presented a rule as to the use of this brake, and also the condition arising where the side pressure of the shoe exceeded the downward pressure of the wheel.

The electric brake permits a more efficient use of the air brake. The electrically-operated brake makes it possible to place the brakes in all the cars at once and not in rotation, and all possibilities of slack would be avoided, besides affording a greater retarding force, thus reducing the length of stop. The degree of effectiveness would be increased to about 20 per cent., whereas the pneumatic brake amounts to about 8 per cent. of retarding force.

Passenger trains with electric equipment are only available for electrical equipment. It is not at present available for freight cars in long train traffic. The number of applications and the amount of braking force were such as may be desired to suit the emergency, while the danger of the brakes sticking would be entirely avoided, the service and quick action being separate. Trains could be stopped in less than 1,000 feet, which in common practice takes over 18,000 feet. Mr. Turner feels confident that a highly satisfactory result of the experiments in electrical brake equipment will be concluded at an early date.

Secretary and Treasurer's Reports and Selection of Next Annual Meeting Place.

The Secretary reported a membership of 1,061, of which 404 attended the convention. The Treasurer reported a cash balance of $7,500.

Chicago was again selected as the place where the next convention would be held.

[illegible]

Mr. J. R. Scott, president St. Louis & San Francisco; Mr. B. J. Feeney, first vice-president, Illinois Central; Mr. H. F. Henson, second vice-president Norfolk & Western; Mr. W. L. Robinson, third vice-president, Baltimore & Ohio; Mr. G. A. Kell, fourth vice-president, Grand Trunk; Mr. A. G. Kinyon, fifth vice-president, Seaboard Air Line; Mr. David Meadows, treasurer, Michigan Central; and Mr. W. O. Thompson, secretary, New York Central.

Trespassers on the Baltimore & Ohio.

The officials of the Baltimore & Ohio Railroad are showing good sense on the handling of young trespassers and others not so young. Incident to a campaign against unlawful riding and trespassing which the company is pursuing in an effort to reduce the number of accidents result- [illegible] no business on the property, officers of the road recently found it necessary to arrest six men and eight boys in a day in one of the suburbs of Pittsburgh to remove them from the danger of the tracks and yards. The ages of the boys ranged from twelve to sixteen years and officials of the railroad believe that by turning these children over to the city authorities the lives of some of them were saved. The railroad has enlisted the help of school authorities, pastors and Sunday school teachers to caution children against the danger in trespassing upon railroad tracks and "hooking rides" on trains, and if the general public would take as much inter- [illegible] safety, the results would be more beneficial.

Railway Mileage in Canada.

The annual report of the Dominion Comptroller of Railway Statistics for the fiscal year 1914, which has just come from the press, states that the aggregate of railway mileage officially regarded as being in operation on June 30, 1914, was 30,795, or 1,492 miles more than on the corresponding date of 1913. Distributed among the various Provinces the operating mileage of Canadian railways during the past eight years was:

The western Provinces had by far the largest mileage under construction in 1914. In Alberta there were 3,054 miles of new line surveyed, 805 miles under contract, and 1,189 completed but not yet in operation; in Saskatchewan, 3,458 miles surveyed, 340 under contract, and 555 miles completed but not in operation; in British Columbia, 3,578 miles surveyed, 1,235 under contract, and 698 miles completed but not in operation; in Manitoba, 354 miles surveyed, 108 under contract, and 134 completed but not in operation; in Ontario, 532 miles of new lines surveyed, 1,841 under contract, and 836 miles completed but not in operation. For the whole Dominion the mileage in process of construction during the fiscal year 1914 totaled 11,472 surveyed, 5,521 under contract, and 3,417 completed but not in operation.

Australian Continental Railway.

The Australian Transcontinental Railway will be finished by the end of 1916, according to a recent report by the chief engineer, N. G. Bell. On the West Australian section the final locating survey has been made for a distance of 260 miles and preliminary surveys as far as the South Australian boundary. The line has been completed ready for track laying for 240 miles in West Australia and 264 miles in South Australia.

Cheating Inventors.

The manufacturing world has been very slow to consider it fair or equitable that payment should be made for the use of inventions that reduce the cost of operating. When the owners of mechanical industries first began to use steam boilers coal was burned in an extremely wasteful manner. Inventors soon began devising arrangements that saved a large portion of the coal when properly used, as much as one half in some cases. When this kind of saving began to become properly realized the users proceeded to cheat the patentees. Cheating patentees has been one of the most common ways of depriving men of their just rights and the practice has by no means been abandoned. Many persons who respect other forms of property have no hesitation in cheating inventors. They have no compunction in possessing themselves of property that has resulted from mental effort.

Catechism of Railroad Operation

Broken Wheels, Springs and Hangers, Equalizers, Eccentric Straps and Rods

Third Year's Examination.

(Continued from page 302, September, 1915.)

Q. 261.—How far would you go with broken engine tender truck wheel, and what action would you take?

A.—I would go to first siding, only, get in to clear main line and notify the proper officials, so that they could send out a truck to replace broken one.

Q. 262.—What would you do with broken arch bar on tender truck?

A.—I would place blocking on top of both boxes on disabled side, and put a tie or piece of railroad iron from box to box, then sling a chain around tie and body of arch and drive wedges between chain and arch so that tie would carry weight in place of broken arch bar.

Q. 263.—What would you do if spring were broken in tender truck?

A.—If it was an eliptical or coil spring, I would remove the broken parts necessary, raise bolster and fill in with blocking to carry end of bolster level. If it was the modern truck that is like engine truck, would raise truck frame and block under frame on top of equalizers as near the center as possible.

Q. 264.—What would you do if bolster were broken in tender truck?

A.—Raise tender and put pieces of railroad iron or ties across from arch to arch, to carry tender up level, chain broken bolster up to them to carry it.

If it is the style of truck that has sand plank from side to side, the ends of broken bolster will rest on it, you can raise the tender and cut a piece of tie so it will lay on top of bolster between arches, let tender down on it and in that way get some use of the springs.

Q. 265.—What defects disable engine and tender truck wheels?

A.—Sharp flanges, broken flanges, broken tread, wheel loose on axle, wheel broken, tire loose on wheel, bad sand holes, flat spots, and wheel cracked.

Q. 266.—How would you carry disabled end or corner of truck, where tender had no suitable stay plates to place tie on?

A.—Would place blocking inside of flange on top of tender and pass chains around body of tender to carry disabled end of truck, or could pass chain under disabled box and fasten it to solid frame of tender forward and back, and in that manner carry the disabled truck.

Q. 267.—What would you do if front driving spring or hanger broke on an American type of engine?

A.—Run the back driver up on a wedge as high as possible and block on top of main box, then run the back wheel down and run the main wheel up and pry up end of equalizer and block it level, putting blocking on top of frame under end of equalizer, if necessary, remove some of blocking from top of main box so that engine will ride level. NOTE.—In handling driving spring breakdowns, remember that the fulcrum for equalizers or intermediate springs is attached to the frame so when you raise the frame you also raise the fulcrum and make it easier to pry up the ends of the equalizers or intermediate springs to block them. NOTE.—When frame is rigid on box, especial care and lubrication must be given box, as it will run hot.

Q. 268.—What if front driving spring is broken on a mogul or consolidation engine?

A.—Run number two wheel up on a wedge and block on top of number one driving box under the frame, run number two down and run number one wheel up on wedge and pry up the end of cross equalizer and block it level.

Q. 269.—With main driving spring broken on a mogul or ten-wheel engine what would you do?

A.—With the arch equalizers on number two and three boxes, would run number two driver up on wedge and block on end of arch equalizer at number three box under top frame rail, then run number two down and run number three up on wedge and block on top of equalizer under frame rail at number two box until got engine up level. With overhung spring at main wheel and intermediate spring between the main and back boxes and the arch equalizers over back box, I would run the back wheel on a wedge and block on top of main box under frame rail, then run back wheel down and run main wheel up on wedge and block under front end of the intermediate spring on top of lower frame rail.

Q. 270.—What would you do if back spring on mogul engine were broken?

A.—Run main wheel on wedge and block on forward end of arch equalizer at back wheel, then run main wheel down and run back wheel up on a wedge and block on top of back end of arch equalizer under top frame rail. NOTE.—If main spring is overhung you can place the blocking in the stirrup of spring hanger that straddles top frame rail, and in that manner put that spring in use.

Q. 271.—What would you do if Elie (Bissel) bolt broke?

A.—Run both truck wheels up on wedges as high as possible, that will raise the front end of long equalizer (which rests on axle), place tie or piece of railroad iron across frame rails, in front of cylinder saddles, with a piece of plank or board on top of it, sling chain around long equalizer and tie, drawing it up as tightly as possible, drive wedges between tie and board to take all the slack out of chain, get off blocks and proceed. NOTE.—On some of the latest engines they have a safety stirrup attached to frame, on engines having the safety stirrup blocking may be placed in stirrup under the front end of long equalizer to carry it. Another way is to raise the forward end of long equalizer either with a jack or snub and chain it to the Bissel post, by passing the chain under long equalizer and around the Bissel post, then wedge between long equalizer and chain.

Q. 272.—What would you do if long equalizer were broken?

A.—Snub or jack up engine in front, block on top of number one driving boxes under frame and chain the cross equalizer down to a piece of tie placed under the bottom frame rails, or you can, where possible, block between the belly of boiler and cross-equalizer.

Q. 273.—What would you do if cross equalizer were broken?

A.—Snub or jack engine up in front, block on top of both front driving boxes under the frame, and chain the back end of long equalizer up to a tie placed across top frame rails, remove broken parts necessary.

Q. 274.—What would you do if spring in safety valve breaks?

A.—Screw down on regulating stud, and so get the pieces together in that way, failing in that, would put the injectors to work and cool the engine down as well as save water, then would fit piece of bolt on top of spring and force it down with the regulating screw, or would take spring box off and fit block in on top of valve in place of spring, then put spring box back, and in any case I would have to rely on the other safety valves relieving the boiler of the extra steam pressure, consequently would have to pay particular attention to the fire and be sure that it was not too heavy.

[illegible]

A.—If near turntable, would turn engine and handle train with engine backing up. If near turn table I would chain [illegible] around center casting to truck or by chaining through draw casting between [illegible]

[illegible] centric strap, blade or cam, and was going [illegible]

[illegible] open, if you do [illegible] central, take out cylinder cocks (or remove indicator plugs [illegible] in cylinder, provide for the lubrication, and disconnect link hanger, allowing link to ride on link block. NOTE.—This allows you to handle the good side of engine, and work it at short cut-off, and back-up or go-ahead at will. If I was on a passenger [illegible] I would not disconnect the link hanger, but would work the engine at full stroke in the forward corner, and if necessary to back up, be sure that engine was standing still, free the valve, reverse the lever, to the extreme back corner, support the upper end of link and back up, working steam on both sides of the engine, then when ready to go ahead would be sure the engine was standing still, reverse the lever to the extreme forward corner, (after freeing link), secure the valve in the center of its seat and proceed. Another way—take off the broken parts, and put the back-up eccentric strap and blade on in place of the disabled one, (the back-up eccentric will have to be reversed to allow for the offset where the blade connects to the link), work the engine full [illegible] handling a full train, you can chain the lower end of the link forward and back [illegible] but it is not necessary, chaining the lower end of the link forward and back perfects the valve motion and guards against the hooking up of the engine. Another way—take down both eccentrics and blades, block valve in the center of seat, provide for lubrication and free circulation and lash link to hanger.

Q. 277.—What would you do if the back-up eccentric strap, blade or cam broke and you were going ahead?

A.—Remove broken parts, put reverse lever in extreme forward corner, chain lower end of the link forward and back and proceed, handling a full train. NOTE.—Do not try to reverse or hook engine up while in motion. If it is necessary to back up, be sure the engine is standing perfectly still, then put reverse lever in extreme back corner, move valve to the center of its seat, and back up, working steam on one side. NOTE.—It is not absolutely necessary to chain link forward and back, but by so doing you not only afford a fulcrum for the link and in that manner perfect the valve motion, but it also guards against reversing the engine while it is in motion.

Q. 278.—What would you do if go-ahead eccentric strap, blade or cam broke and you were backing up?

A.—Remove broken parts, put reverse lever in extreme back corner, support the upper end of link forward and back, with a chain, and handle full train.

Q. 279.—What would you do if back-up eccentric strap, blade or cam broke, and you were backing up?

A.—Remove broken parts, put reverse lever in the extreme back corner, clamp the valve central on its seat and provide for lubrication and free circulation. Another way—Remove broken parts, remove or disconnect valve rod, block valve centrally on the seat, disconnect link hanger and allow link to ride on block, chain the lower end of link forward and back and provide for lubrication and free circulation. Another method—Remove both straps and blades, lash link to hanger, block valve centrally on seat and provide for lubrication and free circulation. NOTE.—The same method may be applied to the back-up eccentric as to the go-ahead eccentric, that is in case of the necessity for handling a full train backing up, take off the broken parts and substitute the go-ahead eccentric strap and blade for the broken back-up, all that you need to do is to change the oil cups and turn the go-ahead eccentric strap and blade over so that the offset in forward end of the blade fits the link, then work the engine in full back motion, securing the top end of the link forward and back.

Department of Questions and Answers

Grate Area and Heating Surface.

[illegible] What is the general locomotive practice in regard to the ratio between the total heating surface and grate area? A. The following figures on which an estimate may be based are selected at random from locomotives recently constructed: Burlington, Pacific type.—grate area, 58.7 sq. ft. heating surface, 3,364 sq. ft., Burlington, Mikado type.—grate area, 78 sq. ft., heating surface, 4,465 sq. ft. Lehigh Valley, Pacific type.—grate area, 87 sq. ft., heating surface, 4,962 sq. ft. Lake Shore, Mallet type.—grate area, 81 sq. ft., heating surface, 5,289 sq. ft.—superheating surface, 1,235 sq. ft.

Tonnage Rating of Simple and Mallet Compounds.

[illegible] you give me a way of finding the tonnage [illegible] What I would prefer is a simple method [illegible] tractive power of the locomotive, if sim- [illegible]

Where T = rated force at rim of driv- [illegible]

P = the boiler pressure in pounds per square inch.

C = diameter of cylinder in inches.

S = stroke in inches.

D = driving wheel diameter in inches.

In case of the Mallet type of locomotive the formula is:

$$T = \frac{C \quad S \quad 1.2\,P}{D}$$

Having ascertained the tractive power of the locomotive the resistance of the train may be calculated as follows:

Resistance due to speed at 20 mi. per hr.	7
Resistance due to grade, one per cent.	20
Total resistance in pounds per ton..	27

Hence the tractive power divided by 27 will show approximately the number of tons that may be hauled by the locomotive. The resistance of the locomotive, of course, decreases the amount of tractive force available for the train, and averages from 5 to 8 per cent. of the total tractive power.

Double Heading Freight Trains.

S. C. B., Macon, Ga., writes: We are double heading freight trains with small engines that have but one 9½ inch pump and a small main reservoir, and under some conditions the one pump will not keep up the air pressure on the train and in such cases it is our practice to keep the pump on the second engine cut in and when the head engineer wishes to apply the brakes he signals the second man who places his break valve handle on lap position. We have been successfully handling trains of from 40 to 60 cars in this manner and I wish to know if this is an entirely safe practice or if it is a violation of the U. S. Safety Appliance Law or the Interstate Commerce Regulations? A. We know of no law which specifically forbids the operation of train brakes in the manner you mention, or that will prevent the second man cutting in his brake valve to assist in charging a train of cars, but the railroad should have rules to cover such cases. It is universally understood that when two or more locomotives are made up in a train, the brakes are to be handled from the lead locomotive and the stop cocks in the brake pipe under the brake valves of all other locomotives must be closed, and while you may violate these instructions and have no trouble whatever, it may result in a serious accident and you would never be able to convince a judge and jury that you were not guilty of criminal carelessness by resorting to this questionable practice in train brake operation. We would suggest that you bring this matter to the attention of your Division Superintendent, as the practice is really

unnecessary as there are several double-heading devices on the market which might be tried out and if they prove unsatisfactory, a separate pipe and hose connection between the main reservoirs of these engines can be installed at a very small cost.

Brake Cylinder Pressure Developed.

W. J., Harrisburg, Pa., writes: Can you tell by the locomotive air brake gages what brake cylinder pressure is being developed in the brake cylinders on the cars in a train? A.—Certainly not. The amount of pressure developed in a car brake cylinder depends principally upon the length of brake cylinder piston travel, brake cylinder leakage and the actual amount of reduction that has taken place in the auxiliary reservoir. As an example, a 10-lb. brake pipe reduction will result in approximately 25 lbs. brake cylinder pressure on the locomotive when a distributing valve is used, because the pressure chamber volume and the capacity of the application chamber and the application cylinder are fixed, but this same reduction may result in 10 lbs. or less brake pressure on a car if the piston travel is excessive, or it may result in 40 to 45 lbs. cylinder pressure if the travel happens to be taken up to 4 or 5 inches. What you probably have in mind is that the pressure registered by the brake cylinder hand of the gage will indicate what the car brake cylinder pressure should be if the piston travel was maintained constantly at about 7½ inches with no brake cylinder leakage, and all brakes were to apply uniformly.

Split Reductions.

W. J., Harrisburg, Pa., writes: What is meant by the term "split reduction" in reference to the application of air brakes? A.—This term is a recent addition to air brake nomenclature and means that the initial reduction of an application, when handling passenger trains, should be divided. Certain changes in air brake equipment and in operating conditions necessitates revisions in the recommended practices to be employed in handling trains in a manner that will, so far as possible, eliminate shocks and rough stops. Several years ago it was decided that the logical method of applying brakes on passenger trains was to make a heavy initial brake pipe reduction of from 18 to 20 lbs., the object being to obtain a high brake cylinder pressure when the speed of the train is high and that it was essential to a smooth stop to reduce this pressure as the speed of the train is reduced in order that the train may be brought to a stop with a very low brake cylinder pressure. This works out very well with the exception that the heavy initial reduction at times and under certain conditions tends to produce a shock in the train and to eliminate this the split reduction is recommended so that instead of making a straight 15 or 18-lb. reduction, 7 or 8 lbs. is made and as soon as the slack in the train adjusts itself the rest of the desired reduction is made.

Defective No. 5 E. T. Brake.

A. H. B., Danville, Va., writes: What could be wrong with the brake on an engine when the black hand of the air gage drops back 10 lbs. when the independent brake is applied, and when the brake becomes fully applied, the hand again moves back to 110 lbs. and remains there. Engine equipped with the No. 5 E. T. brake? A.—The fall of the black hand of the air gage indicates that a brake pipe reduction has occurred as a result of the flow of pressure from the main reservoir to the brake cylinders, and to determine the cause it is well to first note how the supply pipe to the distributing valve is installed. If the connection is made from the feed valve pipe, there must be a check valve between the point of connection and the brake valve and it will indicate that this check valve is leaking, thus permitting a back flow from the brake pipe through the brake valve while the feed valve is supplying the brake cylinders. If, however, the distributing valve supply pipe is connected with the reservoir pipe in the usual manner the fall of the brake pipe pressure while the independent brake is used, indicates an obstruction in the reservoir pipe. In the latter case the red hand of the gage will also drop if the gage pipe connections are made according to print.

Diaphragm Stem of Signal Valve.

A. H. B., Danville, Va., writes: What is the object of the projection at the lower end of the diaphragm stem of the Westinghouse and late type of New York train signal valves? A.—This projection is left for the purpose of allowing a slight movement of the diaphragm and stem without resulting in a blast of the whistle. By extending about 1/32 of an inch into the cavity in the seat of the diaphragm stem, a very slight signal pipe reduction or a light jar that might bounce the stem off its seat will not permit enough escape of pressure to give a blast of the whistle.

Defective Feed Valve Bracket.

E. B. H. Needles, Calif., writes: On page 303 of the September magazine, there appears a question and answer on a "Defective E. T. Brake" and it is not my intention to find fault, criticize or conduct a technical examination as I was accused of when merely calling attention to an article on air brakes in a certain mechanical publication, but in the answer in this question I wish to point out that the size of port J in the rotary valve of the brake valve, which will supply the leakage referred to with the valve handle in lap position, is such as it would make the test spoken of of no value, especially when it is stated that we have a feed valve that is absolutely correct. After having tested the other parts of the equipment as explained in previous publications of your magazine, we would have no air whatever in the feed valve pipe beyond that which would flow by a gasket leak or a sand hole in the feed valve bracket. Now in making this test I would suggest moving the brake valve to release position instead of lap position, and release the tension of the regulating spring of the feed valve and remove the spring box altogether and if there is a blow at the brake pipe port in the feed valve it is either from the gasket or a sand hole, and as we have tested the other parts, any air coming from the brake valve warning port is from the feed valve pipe. A. In an effort to make the answer to the question referred to as brief as possible, an accurate test to locate a defect in the feed valve pipe bracket was omitted for the reason that the reading of the original question indicated that a large volume of leakage was entering the feed valve pipe, causing a prompt equalization with the brake pipe with the brake valve handle in running position so that it could be readily detected by the method outlined or by the one given by Mr. Hon, either of which would serve the purpose but neither would constitute an accurate test for a flaw or sand hole in the feed valve pipe bracket for in one case the air pressure is entering the feed valve pipe is open to the atmosphere through the warning port of the brake valve. In order to make this test the feed valve pipe should be disconnected and the feed valve bolted to the bracket with a "blind" gasket, then when the reservoir cock is opened, any leakage from the end of the disconnected pipe will indicate a defect in the casting. This method of testing one part at a time, or avoiding the test of two or more suspected parts at the same time, gives less opportunity for deceiving ourselves during any test of air brake apparatus. As to the volume of air entering the feed valve pipe when the brake valve handle is in lap position, we would call our correspondent's attention to the fact that this flow is not governed by the size of the port J in the brake valve rotary, as but a very small position of it is open to the feed valve pipe when the handle is on lap position and if the valve handle is crowded back partly on the shoulder between lap and holding positions there will be no flow whatever into the feed valve pipe. As to our attitude toward criticism from any of our readers, we will be pleased to print any comment whatever on our pages and appreciate the interest taken by the author, for we have not yet attained such a point of perfection in journalism that a mistake is impossible.

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Predicted Revival of Business.

What appear to be [illegible] reports say that during the months of July and August the [illegible] its one thousand miles of main line tra- [illegible] the indications are that the wheels of industry [illegible] makers of railroad appliances is over for the present is, that the line has ordered [illegible] template purchasing several triple articu- [illegible]

In regard to the hard times for railroad men happily passing away for the present, much suffering has resulted and we do not think that some officials in charge of railway operating have displayed the consideration for the employees that might have been expected. Railroad men high and low constitute one official family that ought to be fostered as far as business principles would permit, but in many cases this has not been done. The old vicious practice to shorten held along the line as soon as there were indications of business falling off, in order to keep the earnings ahead of expenses has been the rule. This policy gives an air of thrift to the management and ekes out a dividend occasionally which makes quarterly reports read well, but it is short sighted policy. Net earnings are very desirable at all times, and the proper way to keep down expenses, is to keep the road and equipment in such condition that trains may be run with the least possible wear and tear. Observing men have been convinced long ago, that the better condition in which a road and its equipment is kept the greater will be the profit in the long run. Were the inevitable fight of competition for traffic comes about, the road that is in the poorest physical condition suffers the greatest loss and performs its business under greatest difficulties.

When trains are laid off for want of business there will be no use for the crews, and they must take a vacation or seek employment elsewhere; but it hardly seems wise to stop all repair work when much of the rolling stock ought to be overhauled and put ready for the business that is certain to come in the near future. With the brief revival of business that has now come we understand that some roads have the repair shops overwhelmed with cars waiting to be worked into running order, a work that ought to have been done when the cars were standing on the sidings all over the system.

Wise managers take advantage of slack times for business to put everything in good order for the rush that is certain to come and such roads are called "lucky" because they have [illegible] and the heavy business is carried without accident. When [illegible] that equipment for repairs are not coming in fast enough to employ the full shop force, the spare men [illegible] are employed [illegible] in good time [illegible] that is made in the home shops wears in service better than contract shop equipment and is therefore more profitable to the owners. If the plan of home manufacture is followed, some material must be kept in stock; but the advantages arising would much more than offset interest on cost of stock. The interest will be figured with the cost of keeping material in stock, any way, but there is great difference between whether the amount is formed with the net earnings or must be borrowed.

There are circumstances under which it is economy to reduce the payroll but the practice is too prevalent for the good of all concerned. To employ a sufficient force to put permanent way in good condition before winter sets in and then reduce the force when work cannot be done to advantage is sound policy and good business. Before reducing the payroll for permanent way work it is well to consider how it will affect the track conditions during the winter months. That is too often left out of consideration, and the rough riding so prevalent when the frost is leaving the ground, is frequently the result of too much saving on repairs in the fall of the year.

Industrial Exhibitions.

The idea that a merchant has in exposing the goods he has for sale in shop windows in the simplest form of display advertising. It is a long time since the venders of goods conceived the idea of showing what they had for sale in a great public exhibition managed by state or municipal authorities. The tendency in that direction has kept increasing till now in this year of grace there are two industrial exhibitions in the State of California worthy rivals of all the displays of the kind civilization has promoted.

Many people otherwise well informed believe that the first industrial exhibition of any consequence, and the originator of that kind of advertising was the great London International Exhibition of 1851, which was zealously supported by Prince Albert, Queen Victoria's consort, but that is a mistake. To the British Society of Arts the credit is due of having originated national industrial exhibitions. As far back as 1761 that organization offered prizes for agricultural and other machines and had an exhibition of these in its own apartments. The enterprise did not prove a success. Great Britain held nearly a monopoly of machine making and those interested had no desire to display their products to rivals.

The energetic promotion of industrial exhibitions was due to Napoleon Bonaparte, whose purpose was to take business away from British manufacturers. In 1798 he began promoting a series of exhibitions and a gold medal was offered to the exhibitor whose product dealt the heaviest blow to British industries. French expositions were subsequently held in 1802, 1806, 1819, 1823, 1827, 1834, 1839, 1844 and in 1849. The great success achieved by the London International Exhibition of 1851 seemed to put an end to the repeated French expositions. Among modern industrial expositions have been those of Paris in 1855; London 1862; Paris 1867; Vienna 1873; Phila-

delphia 1876; and after that they have been held almost annually in different parts of the world.

An industrial exposition makes a fine attraction to any city but it is doubtful if those incurring the chief expense connected with such a display find exhibiting a paying enterprise. The French government have always discouraged their manufacturers from patronizing exhibitions in foreign countries with the idea that exhibiting reveals secrets of production. This, says the *Canadian Engineer,* with which we agree in the following comments, is probably the reason why Great Britain and Germany declined to send exhibits to the Panama Exposition. The exhibitors who have incurred great expense and trouble expect something more tangible than the fact that thousands have enjoyed themselves. The tendency of these great periodical institutions is to fail to make the fullest use of the educational features of exhibitions.

Exhibitions are highly essential, especially in a new and developing country. The older countries appreciate their value, and devote great efforts to utilize the opportunities of showing the public what can be or is done. One of the important functions of an exhibition is to display goods, machinery, local products, works of art, and other things which will indicate what progress is being made and of what value they are to the country. If the exhibit is an agricultural implement or machine it would be a source of education if some of the primitive makes were preserved and shown in the same building.

Each exhibition must necessarily have its own local color. It would manifestly be useless exhibiting mining machinery in an agricultural community. It must, and will cater to the needs of the people, and, therefore, to have its full educational value it should have exhibits which will kindle the interest of those who have not previously seen the machinery or things that were used in former days, and to revive the memory of those who have. The farmer, builder, merchant, engineer have each their requirements to be satisfied and their thoughts directed to improvements. The engineer, for example, finds that in the rush of daily work many changes take place which have escaped his observation, and at the Exhibition hopes to replenish his knowledge of new things and to familiarize himself in the details of improvements, which he may, sooner or later, have to use; at any rate, he desires to be *au fait* in everything that concerns his profession.

It would be useful to him if it were possible for the exhibitors to hold meetings at which they could describe any particular quality or capacity which they claim for their goods. By this means the maker and the client would meet and mutually discuss matters, and both be benefited. The engineers also might hold meetings for the purpose of discussing subjects of interest, perhaps associated with something shown in the exhibition, and also having social intercourse. These suggestions will, of course, apply to other professions and trades as well. The point to be made is that an exhibition should be made to have as powerful an educational influence as possible, and also be made attractive in other respects.

It is not contended that these features are absent at present, for that would be absurd. Exhibitions, to those who seek for information, always have a great value. New ideas and contrivances, improved materials and better methods of application are to be seen, whereas it would otherwise entail great trouble and expense for the visitor to obtain the same information by any other means. And while this is the case, it is well that the visitors should reap the advantages to the full, and the exhibitors be assisted to benefit in his enterprise.

Dining Car Politeness.

We are doubtful if the selection of dining car conductors receives the careful attention that the selection deserves. On most dining cars the treatment given to patrons is entirely satisfactory, but on some systems the treatment given accords with the prospect of the tip expected. The Erie Magazine has this to say about treatment in the dining car:

It is a very easy mater for a dining car steward or waiter to be "nice" to a high executive of the road, but it is another matter to be nice to the horny-handed farmer that happens along, to partake of a meal in a dining car. How nice the steward can be to the handsome little blonde or stunning brunette, but how hard it is to be equally nice and civil, equally solicitous and polite, to the plain little old lady, who expects and generally gets nothing but her money's worth in accomodations.

Now, just stop and reflect a moment, Mr. "Steward." Everybody is nice to the high executive, to the pretty blonde and brunette, to big and notable folks, male and female. These prominent, pretty or pampered folk expect that treatment; it is not new or novel to them; you have to be nice to them or there will be trouble. But, they don't "advertise" you for it, nor remember that you were so nice and attentive; it is your duty and you should do it, but you make no "hit" with it. Does the steward or waiter want to make a real "hit"? Let him see how nice he can be to those who come to his dining car, who are not accustomed to having dining car people treat them real nice.

But, this "being nice" must be sincere. Be sure that the "common person" who has been treated in a common way, may suspect your sincerity, because, being usually treated in an indifferent and perfunctory manner, he wonders why anyone should show him anything different, and suspects there is an ulterior object. When he comes to leave the dining car and has found the steward and waiter the "pink of politeness" and obliging to the limit, without reward or hope of reward beyond the regular per diem, he departs with a deep sense of kindness, of appreciation, and says over and over when talking about dining cars, "The Erie has the nicest dining car I ever ate in."

Yes, Sir, being "nice" pays big dividends, but you must have it in your heart, not do it hypocritically; not wear it as a mere veneer, but do it because, as a dining car man, a servant of the public, you owe it to every mother's son and daughter to be "nice" to them in your dining car.

More Light in Workshops.

An occasional correspondent writes: "I am under the impression that RAILWAY AND LOCOMOTIVE ENGINEERING exercises very great influence when it attacks any abuse or advocates any improvement, so I am writing to ventilate a personal grievance. I am a machinist engaged working on piece work in (shop named which we have reached privately) and the sombre weather, that has been so common this year, has prevented me from doing nearly all the work that could have been performed under sufficient light. My real grievance is that no attention is paid to keeping the windows clean that light may penetrate and dispel the darkness."

We thoroughly sympathize with the writer in that letter and have brought the subject before the master mechanic in charge and we strongly feel inclined to touch upon the subject of defective shop lighting. Shop superintendents who do not have exact work in badly lighted shops frequently fail to appreciate the fact that daylight is much better and cheaper than artificial light.

In old shops built when it was the fashion to make small windows and low roofs, the need of more light is often very seriously felt. In cloudy weather it frequently becomes necessary to use artificial light in the middle of the day which in itself ought to constitute a demand for improvement. In our travels we frequently encounter shops where the windows are usually small and the daylight obstructed by adjacent buildings, while to make conditions worse the grime of smoke and dust upon the windows permit very little light to pass through. Such shops would turn out much more work if soap and water was used freely upon the windows.

We are aware that shop foremen and

tomed to obstructed lighting facilities in their shops that they do not realize the fi- [illegible] If we stir up some of them to let in more light this article will have fulfilled its mission.

Prejudiced Against Balanced Valves.

It is within the memory of people still living that once upon a time railroad men from foreman to master mechanic had no use for balanced valves and held that the extra parts cost unnecessary money, were troublesome, given to breaking and failed to reduce friction. I was an engineer in those days holding grimly to the gospel "that the fewer the parts you have on a locomotive the less danger of breakage there will be."

I was well acquainted with George Richards, inventor of the well known safety valve and George was given to talking about the useless strains put upon the locomotive mechanism by the enormous pressure of steam wearing the slide valve, and most of us were inclined to make fun of what he called his idle theories. One day after much persuasion, George got permission from Mr. Underhill, the superintendent of motive power of the Boston & Albany Railroad to put a set of balanced valves on one of the passenger engines. The act was soon forgotten and the engine kept on making its 400 miles a day for four years when she was taken in for repairs. The shop foreman then examined the valves and their seats finding everything in such [illegible] necessary. A report of this condition of the valves was reported to Mr. Underhill and it led to the introduction of balanced valves upon the Boston and Albany and many other railroads.

Sabotage.

[illegible] ants and inferior workers in Europe. Some time ago when conflicts arose between workers in European factories and [illegible] a sabot among the parts of moving machinery with disastrous results. That practice was carried on so extensively that it received the name of sabotage.

There is a virago in the United States named Elizabeth Flynn, who is a warm adviser of sabotage as a fighting weapon. [illegible] she said it was the withdrawal of efficiency on the part of the worker in the case of a fight for better conditions and a method of hitting the pocket of the employer.

She then cited cases where workers [illegible] work and produced less until the wages were restored to what they had been.

The speaker declared that the employers taught sabotage to the strikers unconsciously by weighting the silk in its preparation with solutions of metals.

Another kind of sabotage, she said, was the "open mouth" system. The waiters who struck in the hotels, she said, used it by describing to everybody exactly what happened to the food in the kitchens before it was furnished to the guests, and it proved an effective weapon.

"I repeat," she said, "that sabotage is not violence, and is a necessity for the workers who are fighting for better conditions."

There used to be a feeling among employers and employed that fair play ought always to prevail between contending interests. This Miss Virago Flynn has no sense of fair play and her influence is vicious.

The Engineers and Firemen.

The joint board of the Brotherhood of Engineers and the Brotherhood of Firemen has sent to all local bodies of their organizations a call which recites that "the railroad brotherhoods, wherever organized, are beginning to realize that all the orders must work together in their struggle with the railroads to gain shorter hours, higher wages, and better working conditions."

It is right and proper that the organizations mentioned should exert their combined power to compel their employers to grant them higher pay and better working conditions, but few railroad companies are in a position to increase the wages of their employees when rate regulating authorities are striving all the time to reduce railroad rates. The railroads are thus held between two horns of a grave dilemma—reduced revenue on one side and increased expenditure on the other. We favor increased expenditures but we think that the brotherhoods who are so powerful in forcing fair treatment for themselves should use their influence in defending railroad revenues from the rapacity of rate reducing rascality.

The Crime of Prosperity.

We are hearing a great deal these days about "unfair" business. On giving this subject much thought and some investigation, we find that the complaints about unfair business are raised by people and companies that are beaten in the conflict of competition. Men deficient in energy and business capacity attempt to compete with those the opposite in every way, or when they fail to make good raise whining complaints that their successful rivals are succeeding by unfair methods.

[illegible] legislatures there are measures pending that are promoted by business weaklings, to put unfair burdens upon successful rivals. Most of the legislators who support such unfair measures, do so for favors received or expected. No interests have been so deeply wounded as railroads by this iniquitous species of legislation. Persecuting railroads has become unpopular of late, and some miserable legislators have been turning their guns upon any concern reported to be prosperous and making money. A nation has fallen into dangerous times when industry and its resulting prosperity is regarded with suspicion.

The Joseph Dixon Company.

Most of our readers are familiar with the name of the Joseph Dixon Crucible Company who have been supplying graphite to railway companies time out of mind. It needs a long stretched memory to go back to the time when the Joseph Dixon Company was not doing business. They have employes who have been with the Dixon Company more than fifty years, quite a few who have been more than forty years and a really long list who have been in the company's employ more than twenty-five years. We would also say that boys who came with the Dixon Company as mail boys or as factory boys and started on the pay roll at $2 to $3 per week, are today in positions of trust and even as officers or superintendents of the company.

The Dixon Company, like many other large corporations, never goes outside to look for a man for any position if it can find the proper man among its own ranks.

Where Loyalty Is Due.

The great mass of people who earn a living by working for railroad companies are not celebrated for loyalty, very small grievances frequently causing strikes that mutual forbearance would settle without strife. Yet most of the railroad companies treat their employes more kindly and with greater generosity than individuals and small firms do.

The Pennsylvania Railroad Company is not by any means the most benevolent transportation company in the United States but it has more than 2000 active employes who have been in the service of that railroad more than forty years, and more than 1,500 men who have served forty years or more and have been placed on the roll of honor and retired.

There are approximately 500 men on the Pennsylvania Company's pay rolls who have been in its employ more than fifty years. 4,700 active employes are between sixty and seventy years of age—they are retired at seventy. A comfortable old age awaits the faithful employee on the Pennsylvania, and what more can any human being hope for?

Locomotive Running Repairs

By JAMES KENNEDY

II—Readjusting the Stephenson Valve Gear

Assuming that a new locomotive or one that has been newly and completely repaired has begun its work, it is safe to state that if the work has been thoroughly done, there will likely be little trouble for some time, but it is very safe to assume that the valve gearing will rapidly undergo some change. This is particularly the case in locomotives equipped with the Stephenson valve gear, for no matter how carefully the gearing may have been adjusted when the locomotive was constructed or repaired, variations soon occur. These largely owe their existence to the fact that the valves are moved by a combination of rods and levers that are necessary in conveying the motion from the main driving rod to the valves. These couplings not only wear rapidly and create what is known as lost motion, but their wear is also of an erratic kind that is impossible to provide for in advance, and can only be kept nearly correct in their movement by systematic examinations and careful readjustments made by men of thorough experience in the intricate details of locomotive valve-gearing.

The most common discovery made in looking over the main valves of a locomotive is the apparent variation in the lead or opening of the valve. It is almost always found that the opening has increased at one end of the piston stroke and diminished a corresponding amount at the other end of the stroke. In the case of the Stephenson gearing, a shortening or lengthening of the eccentric rod half the amount of the variation in the valve opening will square the valve, that is, the amount of opening at each end of the stroke will be equalized.

Sometimes it will be found that the lead may have increased in the forward motion and diminished in the backward motion. This may be rectified by moving the eccentrics the amount in which the valve is in error. The direction in which the eccentric has to be moved will readily suggest itself when the locomotive is on either of the centers, when the valve is in position showing the amount of opening. The rocker, it will be seen, reverses the motion so that the eccentric will have to be moved in the opposite direction from that in which it is desired to move the valve.

A common mistake made in examining the valve gearing, which even the most skilled mechanics often make, is trusting to the original wheel markings for the dead centers or exact points where the end of the piston stroke occurs. It is an error to suppose that while these marks may have been correct at the time that they served their original purpose, that they remain correct after the locomotive has seen some service. It should be borne in mind that the rod connections have loosened. The locomotive in its entirety may be nearer the rails on account of the relaxing of the springs, while, of course, the wheel centers retain their original height. The result is that while the main rod may have become lengthened, the space between the center of the main axle and the center of the cylinder may be slightly shortened.

These variations, however slight, affect the wheel markings, and it is time well spent to begin the operation of looking over the valves from the beginning, and make new marks on the wheels, and also prove that the markings are correct by trying the engine, not only in the forward gear, but also running backwards, and so obtain as nearly correct as possible, an exact basis on which to conduct the investigation.

It should also be borne in mind that in construction and general repairing of locomotives the parts of the work are in a normally cool condition; whereas, in practice the engine is subjected in some of its parts to considerable heat. This change in temperature has a marked effect on the valve gearing, and the change is more particularly noted on the reach rod, owing to the expansion of the boiler to which the quadrant is attached. The reverse lever may be readily tried in the extreme forward and backward positions and any marked variation in the position of the link-block should be rectified; otherwise injurious irregularities in the motion of the valves will be produced.

It should also be remembered that in all cases of locomotives that are unfortunate enough to sustain even a slight shock in some apparently trifling collision, they are almost always affected in the delicate mechanism of the valve gearing. This can readily be accounted for from the fact that many of the essential parts of the motion are not traveling in direct paths, and lend themselves readily to distortion and must be reckoned with among the causes that make necessary a systematic and oft-repeated examination of the position and the action of the valves.

It is proper to bear in mind that a slight variation from the correct position is almost inevitable in all valve gearings, and especially so in the Stephenson gearing. This variation may not seem to be of much consequence, but when we remember that not only is the admission of steam at the most effective part of the piston stroke interfered with, but the compression, the point of cut-off, the release or exhaust, and also the exact balancing of the amount of effective pressure on the forward and backward stroke of the piston, are all affected, and all tend to a loss in the economical use of steam, and all contribute to a loss of power, as well as add to the cost of coal consumption which in itself is an item of great and growing importance.

Referring to the point of "cut-off" and confining our observations in the meantime to the peculiarities of the Stephenson valve gear, it will be noted that when the reverse lever is "hooked up," that is placed in a position on the quadrant where the engine will likely be called upon to perform the most of its work, this will have the effect of slightly increasing the opening of the valve at the end of the piston stroke, but the important point is to ascertain the point of cut-off. With the use of the valve train it can be easily determined at what point the valve closes, and assuming that on moving from the forward center on the right side the valve closes when the crosshead has moved seven inches from the front end of the extreme point of travel, and after the crosshead has passed the back end the valve closes after the crosshead has moved nine inches from the end of the piston stroke, it may be at once suspected that there is some organic defect in all probability in the point of suspension in the link saddle which would require to be moved forward or backward and which could be determined by experiment. As the link saddle is securely attached to the link a change in its location may not be possible, and a makeshift compromise may be effected by a readjustment of the valve gear with the lever at the point of cut off, that is by moving the eccentric rods and eccentrics so that the valves will close exactly at this predetermined point. The question will then be one of choosing at which point it is desired to be correct, whether at the full stroke, or at the hooked-up or shorter stroke.

In addition there are other details that affect the mechanism, among which are—the length of the reach rod, shown by the position of the link block at the top and bottom of the link when in full gear at both centers—the length of the valve rod when the rocker is plumb and the engine level, at which point the valve should be exactly in the center of the valve seat.

These temporary and organic changes should never be attempted except by expert machinists. Others will find themselves deep in involved mysteries as difficult as if they attempted to unravel the convolutions of the inner satellites of the planet Saturn.

(To be continued.)

Air Brake Department

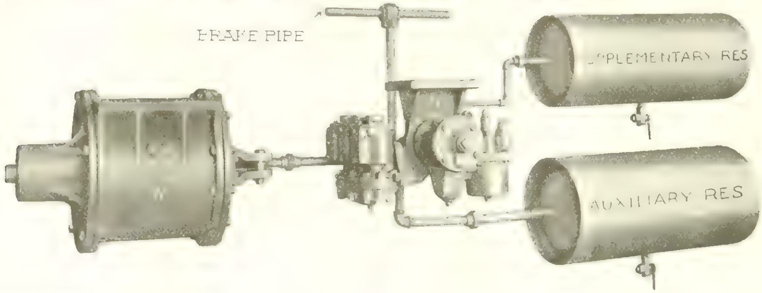
Federal Law Relative to Locomotive Brake Maintenance

[illegible] is a general [illegible] of all brake operation must conform to regulations adopted by the Interstate Commerce Commission which have become a law and a violation of which may result in heavy [illegible] may result [illegible]

[illegible] at least 85 [illegible] must have [illegible] rated in [illegible] condition [illegible]

[illegible] as conditions may require, but not less frequently than once in each three months. The diameter of orifice, speed of pumps, and the maintained air pressure for compressors in common use are given in the following table:

Make.	Size.	Strokes per minute.	Diameter orifice. Inches.	Air pressure maintained. Pounds.
Westinghouse	[illegible]	[illegible]	[illegible]	[illegible]
Westinghouse	[illegible]	[illegible]	[illegible]	[illegible]
W[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
New York	[illegible]	[illegible]	[illegible]	[illegible]
New York	[illegible]	[illegible]	[illegible]	[illegible]
New York	[illegible]	[illegible]	[illegible]	[illegible]



[illegible] either in road or yard service with an inoperative driver brake, and that in cutting [illegible] the air brake operating or some designated person must ride the car as a [illegible]

While a strict observance of the above is largely in the hands of the trans[illegible] interest for the air brake inspectors and repairmen, as the following are proposed rules and instructions for inspection, test [illegible] tives and tenders. They are to be submitted to the Interstate Commerce Commission for approval and are in accordance with an act of Feb. 17, 1911.

It must be known before each trip that [illegible] pressors are in condition to provide an ample supply of air for the service in which the locomotive is put, that the devices for regulating all pressures are properly performing their functions, that the brake valves work properly in all positions, and that the water has been [illegible]

Every main reservoir before being put [illegible] cent. above the maximum allowed air pressure.

The entire surface of the reservoir must be hammer-tested each time the lo[illegible]

Air gauges shall be so located that they may be conveniently read by the engineer from his usual position in the cab. Air gauges shall be tested at least once every three months, and also when any irregularity is reported.

[illegible] on a dead-weight gauge tester to 20 per cent. above the working pressure. Gauges found incorrect shall be repaired before they are returned to service.

[illegible] valves, quick action triple valves, straight-air double-check valves, and dirt collectors shall be cleaned as often as conditions require, but not less frequently than once each three months.

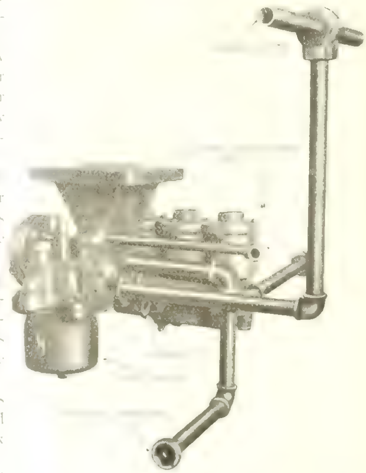
Brake cylinders and plain triple valves shall be cleaned and cylinders lubricated not less frequently than once each six months.

The date of testing or cleaning, and the initial of the shop or station at which the work is done, shall be legibly stenciled in a conspicuous place on the parts, or stamped on metal tags. When metal tags are used, the height of letters and figures shall not be less than 1/8-inch, and tags [illegible]

[illegible] to brake pipe near automatic brake valve, which will show the date on which the distributing valve, control valve or quick action triple valve, reducing valves, straight air double check valve and dirt collectors were cleaned.

One securely attached to air compressor steam pipe, which will show the date on which compressor was tested by orifice test.

One securely attached to cross over [illegible] driver brake cylinder,



which will show the date on which plain triple valves and brake cylinders were cleaned and cylinders lubricated.

One securely attached to the return pipe near main reservoir, which will show the date on which the hydrostatic test was applied to the main reservoirs.

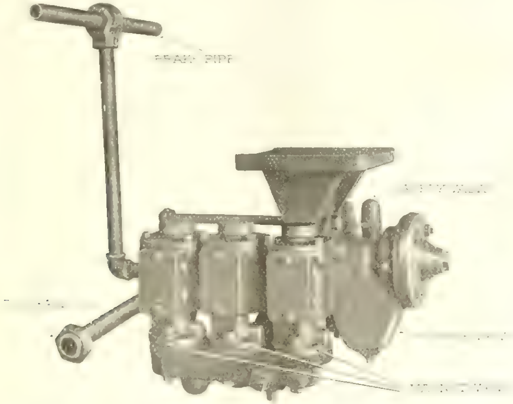
The minimum piston travel shall be sufficient to provide proper brake shoe clearance when the brakes are released.

The maximum piston travel when locomotive is standing shall be as follows:

	Inches.
Cam type of driving wheel brake....	3½
Other forms of driving wheel brake..	6
Engine [illegible]	[illegible]
Tender [illegible]	[illegible]

Foundation brake gear shall be properly maintained. Levers, rods, brake beams, hangers, and pins shall be of ample strength, and shall not be fouled in any way which will affect the proper operation of the brake. All pins shall be properly secured in place with cotters or nuts. Brake shoes must be properly applied and kept in line with the tread of the wheels.

No part of the foundation brake gear of the locomotive or tender shall be less than 2½ inches above the rails.



Main reservoir leakage shall not exceed 3 pounds per minute.

Brake pipe leakage shall not exceed 5 pounds per minute.

Brake cylinder leakage shall not exceed 5 pounds per minute per cylinder from an initial cylinder pressure of 50 pounds.

The train signal system shall be tested and known to be in good condition before each trip.

It will be understood that the above has not as yet become a law, but there is every reason to believe that the suggestions will be accepted with very little, if any, change in the wording, so that any of our readers who may not have a system of inspection, test, and repair work that will approximate the one that is outlined, it may be well to prepare for a tightening up in the near future.

Constant changes and additions are being made to the laws regulating air brakes, and it is our purpose to keep our readers advised of these changes as a knowledge of them is essential to all interested in air brake matters.

Improved Methods of Reducing Roundhouse Delays

Any improvement or method of doing work that will reduce the time locomotives are detained in the round house confers positive benefit upon railroad companies. In discussing a paper on "The Value of a Locomotive," submitted to the Western Railway Club, Mr. George R. Henderson made the following remarks which are well worthy of notice:

When the engine is in the house a big factor in increasing the availability of an engine to handle tonnage is the hot water wash out system. This is universally recognized by all and some of us have quite complete records as to just what saving the hot water washout system effects in boiler maintenance. It is the feature of boiler maintenance or rather the lack of boiler failures on the road that we are particularly concerned in this connection.

Good inspection is another item which if watched closely is bound to save failures on the road. Some lines have what is termed an inspection pit where an engine receives a thorough inspection. Sometimes the inspectors carry a supply of nuts and cotters so as to at once replace any of those missing. This pit is particularly handy where an engine is being given a quick turn and not time to put it on a round house pit.

Other features which might be mentioned are: Enough men in the roundhouse to do the work when needed. The old adage "A stitch in time saves nine," is just as true in the round house as in the tailor shop. Good facilities for doing the work, which should include a small machine shop adjacent to the round house, equipped with drill press, shaper, lathe, bolt cutter and emery wheel, also a small, well-equipped tool room. This machine shop saves a lot of time running back and forth from the big shop. There ought also to be good air and steam pressure.

Running repairs is charged with 2 hours, 41 minutes, or 11.2% of the day. Running repairs no doubt vary closely with the time an engine has been out of shop, and with the thought in mind of reducing the running repairs the road with which I am connected have reduced the mileage between shoppings. There have also been put into effect some changes in detail design, which in many cases eliminate entirely the running repairs. For instance, we cast a brass nub liner on the face of driving box. The result is that it is unnecessary to drop wheels between general repairs, and there is saved the cost of this work, which conservatively is $25.00 for labor and material, and engine out of service 3 days at $44.00 per day, or $132.00. A lesser saving as regards running repairs is made by the use of brass shoe and wedge liners on the driving box. The good effect of these comes out plainest during general repairs. We find them with the tool marks hardly worn out and it is therefore unnecessary to line up and plane the of main driving boxes with its attending shoe and wedge.

Another source of trouble is pounding of main driving boxes with its attending trouble in the road brasses. This means dropping the wheels to repair brasses. It would seem that this work could be greatly minimized by the use of some form of removable brass, although we have no experience with these devices; we have, however, used the so-called long driving box with the result that the trouble was entirely eliminated, together with the advantages of the lesser bearing pressure and reduced wear on axle. The cost to drop a pair of wheels or to crown the brass is approximately $23.00 for labor and three days' loss of engine service while the same is under repair.

To minimize stay bolt trouble, the practice of using some form of flexible staybolt throughout the breeching zone [illegible] estimated this alone to save one or two days in every 60-day period.

[illegible]

With the advent of the gas and electric welding outfits it has been possible to make many repairs that hitherto would not have been possible. Recently we had a Mikado engine with all driving wheel tires slid flat, the flat spots being 2 to 5 inches long and one-eighth inch to one-quarter inch deep. It would have cost not less than $150 to have dropped these wheels and turned the tires, which included the loss in the material. To this

must be [illegible] incurred by having the engine out of service three or four days. We repaired these flat spots with the electric torch in five hours at a cost of \$2.05 for labor and material and \$5 for electric current. Both the gas and [illegible] successfully [illegible].

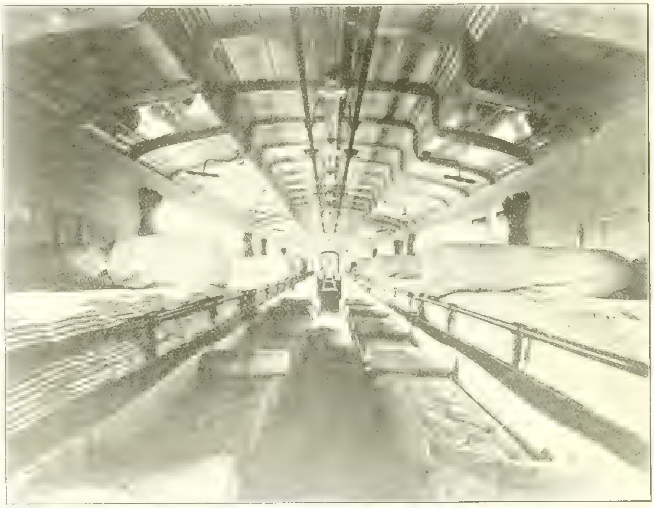
[illegible] Shop Work.

After an engine has made its mileage, it gets a general overhauling, and whenever possible we make our engine candidates for the shop pull a train to the point of shopping. If it be assumed that our engine receives general repairs every 18 months and that 60 days is the average time out of service, that means 11% of the engines are always in or awaiting the shop. Sixty days multiplied by \$44 equals \$2,640.00, the loss while the engine is in the shop.

After the engine reaches the shop the question arises, what improvement can be made then with a view to cutting down the time in the shop? The first thought is modern shop facilities, and, considering that the average engine is worth \$44.00 per day it ought not to be difficult for any one to show substantial savings by the use of modern shops. Assume a shop turning out 30 engines a month, or 360 a year, and that by making certain changes an engine could be turned out four days sooner. The saving then will be 90 engines multiplied by 4 days or 360 [illegible] equal \$15,840.00. Hence it would be considerably more economical to modernize the shop.

Newest British Ambulance Car

The accompanying illustration shows a view of the interior of one of the traveling "wards" which are in service in two newly designed ambulance trains that were completed last month by the London and North Western Railway at the order of the British War office for the use in France of the British soldiers. They contain a complete surgical outfit and every possible comfort and necessity for the transportation of the wounded from the battle line to the base hospitals. These trains are the first of their kind in operation and will be rapidly succeeded by extensive additions, as the exigencies of the service may require.



INTERIOR OF NEWEST DESIGN OF BRITISH AMBULANCE CAR

Against Dishonesty.

Among certain classes of people the opinion prevails that men who achieve decided success in business have done so by sharp practice whose proper name is dishonesty. Dishonesty seldom makes one rich, and when it does riches are a curse. There is no such thing as dishonest success. The world is not going to pay you for nothing. Ninety per cent. of what men call luck is only talent for hard work. Do not lean on others to do your thinking or to conquer your difficulties. Be conscientious in the discharge of every duty. Do your work thoroughly. No one can rise who slights work. Do not try to begin at the top. Begin at the bottom, and you will have a chance to rise, and will be surer of reaching the top some time. Be punctual. Keep your appointments. Be there a minute before time, if you have to lose your dinner to do it. Be polite. Every smile, every gentle bow is money in your pocket. Be generous. Meanness makes enemies and breeds distrust. Spend less than you earn. Do not run in debt. Watch the little leaks, and you can live on your salary.

First African Explorer.

The first white man to explore the wild interior of Africa and the first to reach the previously well-nigh fabulous waters of the Niger was Mungo Park, who was born in Scotland 144 years ago last month. Park was apprenticed to a surgeon, and started his wandering career in 1792 as assistant surgeon on board the Worcester, an East Indiaman. He made a voyage to Sumatra, where his investigations added much to the scientific knowledge of that island and its surrounding waters. The Scotch surgeon was then employed by the African association, and [illegible] 179[illegible] reached the [illegible]. In the following December, accompanied only by two negro servants, he plunged into the unexplored interior of the Dark Continent. A year later he was back in England with the proud distinction of being the first modern European to reach the Niger. In 1805 Park returned to Africa with "the fixed resolution to discover the termination of the Niger or perish in the attempt." At Boussa, Park and his companions were attacked by the natives, and were drowned in attempting to escape the ferocious black men. He has had many successors in his special line of discoverer.

Competition.

"Competition is the life of trade," says an ancient adage invented to reflect conditions that existed when farmers, grocers, tailors, masons and carpenters were the people who gave life to trade by sometimes trying to undersell each other. Competition is the life of trade between individuals or companies doing business on equal footing which was an ancient condition, not applicable to business as it has been done for thirty years. In every line of trade big fishes have grown up that swallow the little fish. The herring has no chance to compete with the shark. The Chicago man had the correct idea when he said that if ever the lion and the lamb lay down together, the lamb would be inside of the lion. That is the style of modern competition.

Passengers on the Interborough.

The Interborough Rapid Transit Company of New York carried 647,378,266 passengers on its elevated and subway lines, a decrease of 4,508,405 as compared with the fiscal year of 1914. The number of passengers using the subway increased 5,172,646, but there were 9,681,051 fewer passengers on the elevated lines.

Heat, Motion and Work, Their Units of Measurement

Early Experiments—Work Is Motion Against Resistance

HEAT

What the engineer has to do with first, last, and all the time, is heat. Its production—speaking in a popular sense—and its utilization, are what mainly concerns him from the time he shovels the coal into the furnace till the exhaust steam escapes into the atmosphere or into the condenser. We speak—and properly enough—about the economical production and use of steam, but water—steam—is only a means to an end. It bears about the same relation to the subject that the harness does to the horse that pulls the load. For various reasons, one of which is that it is about the most common thing in the world, water is the best medium known for transferring the heat in the furnace to the place where it is utilized as motive power.

It was only a few years ago, as time goes, since heat was considered a mysterious something that insinuated itself in some equally mysterious way between the component atoms of matter, with the result of increasing the temperature of bodies and bring about the phenomena known to be due to heat. This idea of heat was that of the ancient philosophers, who, after they had decided upon a thing, gave it but little consideration, for fear they might be called upon to reverse their opinion, thereby acknowledging that they were not infallible—a fear that happily does not exist at the present time. In the times of these old philosophers—the good old times we hear so much about—all investigation, and pretty much all thinking, was done by those who were assumed to be trained to think. It was not supposed that those who worked were capable of doing their own thinking, to say nothing of thinking for others. These old philosophers had a patent on mental effort, and when it came to things of practical value, they made a rather sorry mess of working their patent.

One of the first to see the inconsistency of the old-time theory of heat, was Count Rumford, a Scotch scientist, and he was led to some experiments by observing the heat generated in the process of boring cannon. Any one of you who has ever drilled a hole in metal, knows that the metal as well as the drill is heated, and that the duller the drill—the less freedom with which it cuts—the greater the heat. He was followed by other observers, the observations leading up to the present theory of heat. According to this theory, or, as we may say, scientific fact, because it has been demonstrated beyond doubt—premising that all bodies are composed of atoms almost infinitely small, too small to be seen by any means at our command—heat is simply motion of these atoms, and temperature, as indicated by the thermometer, is the measure of the intensity of that motion. For example, we communicate heat to a piece of iron, and we say the heat expands it; it grows longer. This is because the more violent vibration of the atoms demand more room in which to vibrate. The atoms of iron are held together by a force called cohesion—a force about which we know but little. And if we heat the iron sufficiently, there is war between the cohesive force and the force of heat, and the vibration of the atoms becomes so great as to separate them, so that the iron is melted and cohesion is in part — not entirely — destroyed. More heat will entirely destroy cohesion, and the molten iron becomes gas. Now, to bring this iron from a solid to a molten condition, and then to drive it off in the form of a gas, requires work, and this work is done by the heat that is applied. To bring about these changes in the piece of iron, required that the atoms of iron be put in motion, and the greater the change the greater the motion required. The atoms of the iron were never at rest, because they were never absolutely cold, which is a temperature very much lower than we know anything about by observation. In driving them off in the form of gas, we have increased the intensity of their motion, and hence their temperature. We notice the example of the piece of iron, because its three states, a change from one to the other, requiring the application of heat, and involving motion, lead up to the present understanding of the fact, that motion of any kind is the result of heat; in other words, that heat and motion are substantially synonymous terms; as Tyndall puts it, heat is a mode of motion.

WORK

Work is motion against resistance. When heat is communicated to a body, the immediate result is work, because the motion of atoms is resisted by cohesion, and generally otherwise. But what we want to compare heat with, is another kind of motion; that is, motion that brings about mechanical results; as, for example, the motion of the piston of a steam engine against whatever opposes that motion. Without, perhaps, the best possible authority in the world for doing so, we will, for the sake of getting on common ground, call this motion of the piston of the engine against opposing force, mechanical work. Let us see what this is and what it is not. If, by means of a lever, you try to raise a weight, but do not succeed, you may call it hard work, but mechanically speaking, no work has been done. The weight has not been raised, and to do work there must be motion. If you pick up a weight from the floor you do work, because you raise that weight against resistance. But you may hold it at the height to which you have raised it for a week, and in so holding it you are doing no work, as we speak of work in a mechanical sense. The point to be noted here is, that to do work there must be motion, and that motion must be against resistance. If you block the drive wheel of your engine so that the pistons cannot move, and then bring the whole boiler pressure to bear against the piston, no work is done, because there is no motion of the pistons.

Now, we can, and do convert the vibratory motion of the atoms of a substance into what we term work—that is, motion against palpable resistance. That is just what is being done wherever there is a steam engine in operation. And that is all that is being done. Then this work, that is, the equivalent of it, must go back again to heat. It has gone from heat, in the furnace of the boiler, through the engine, into work, and if we had means of tracing it, it has again appeared as heat, in whatever has resisted that motion. When you find your journal-box warm, some of it is there, and so on all through the connection between the engine and the machinery it drives, or the train it pulls, and the air that machinery puts in motion.

Suppose we screwed down the pillow-block bolts of a stationary engine, until with full steam it would just run itself, then we should find the principal part of the heat we had converted into work right [illegible]

The law of heat and motion is one of those natural laws that we cannot change. Motion, that is work, results from a change in the temperature, and while this change is taking place, we can couple on our little endeavors and get them pulled along a little ways.

[illegible]

We may take, as a familiar example of the transformation of one kind of motion into another kind, a shaft being turned in its bearings against the opposition of friction and attached machinery. In the shaft is tangible motion against resistance, and heat—atomic motion—will disappear from whatever is doing that work of turning the shaft just in proportion to the work required. It requires a definite amount of heat to do a definite

[illegible] would be the case [illegible] consideration [illegible] the fact that all that is done is to change one kind of motion into another kind. In the work of turning this shaft, the motion we call heat has disappeared in one [illegible] another kind of motion. If we could follow the transformation further, we should find this motion of the shaft appearing again as heat, in whatever had resisted the revolution of the shaft. All the heat that is utilized in moving the [illegible] all the heat of which the motion of the piston is an equivalent could, if we had the means of following it up, be accounted for in whatever has tended to stop that motion. Out [illegible]

[illegible]

It is well to impress these facts upon our minds. There are those who say the [illegible] himself about them. If he never aspires to do more than shovel coal and open a throttle valve in a perfunctory manner, it may not make much difference. But the [illegible] this. He wants to know why he shovels coal and opens throttle valves. He expects to study steam engineering apart from running a steam engine. He expects to invent and improve steam engines. And aside from the question of [illegible] the doctor or the lawyer has.

Heroes of the Footboard.

The late Dr. Williams, of the Baldwin Locomotive Works, used to tell the particulars of an incident where, he believed, a locomotive engineer displayed the greatest of heroism that had come within his knowledge. They were out fighting snow [illegible] When they reached the terminus after a night of terrible hardship, the engineer had to be carried off the engine. On making inquiries Dr. Williams found that in in the evening, by the breaking of a water glass, the engineer had one of his [illegible] his work without complaint. When a surgeon who was called removed the man's clothing, the skin peeled off the greater part of the scalded leg.

The *Railway Engineer* of recent date says: "Mr. William Marr, an engine driver on the Withy and Furness has died of injuries received while running his engine. His clothes caught fire when the [illegible] control and brought his train safely to the [illegible] to a hospital where he lingered for a few days when death ended his suffering. Conduct so heroic should be suitably commemorated by his employers and fellow workmen."

Fed the Wild Cat.

A Passenger Solicitor's work brings him up against many different classes of people, takes him into many strange places, he is confronted by many trying situations, and his success as a solicitor, nay, the very life of his job depends on knowing just what to do in every instance, and in doing it. Never was this better exemplified than by an experience which a genial freight solicitor, Sim Glover, went through not long ago. Down in the cactus and sage brush near Podunk, Sim was pursuing some investigations on his own hook, and wondering [illegible] places and so far from it in others, and [illegible] of car freight, when he came face to face with a wild cat. As we have [illegible] just what to do, and doing it. And Sim was right on to the job. From a standing start he did the first hundred yards in nothing flat, and seeing the wildcat close behind him, did the second hundred in a minus two and two-fifths. Still [illegible] reverted to other things—to days when on the farm he had considered pitching hay hard work—he thought of Baron [illegible] bear, escaped by jumping down the bear's throat and turning him inside out. He thought of doing this with the wild cat, but discovered that the cat's teeth were in the way. Suddenly an inspiration seized him—he threw the cat a copy of [illegible] advantage than then. When Sim stopped for breath he was back on our tracks leaning against a "safety first" sign. As he said later "I had never given much thought to this slogan before, but I now realize that I believe every word of it."

Missed Their Calling.

The whole path of life is strewn with the wrecks of men who undertook to do something they were not fitted for. The writer was one of a group of apprentices in a railroad shop, all of them thinking that they were entering upon the calling for which nature had fitted them. All started out with the same opportunities. At the close of four years apprenticeship some of the boys abandoned the business because they were failures in a machine shop. One of them might have made a successful lawyer for he was gifted with superfluous gab, one of them entered a druggists shop and afterwards called himself a doctor, one of them returned to the farm, and several others drifted with various occupations that called for small mechanical skill. One did his first firing for the writer and at last accounts was pulling passenger trains on the Santa Fe. He turned out a better engineer than machinist. At the same time I have met many men who were ambitious to become locomotive engineers and made miserable failures.

Some time ago the claim was made that railway companies were getting things down fine and that the boys would have to keep accurate step and so they will. The status of the American locomotive engineer is being raised to a higher standard, and right it is that it should be so. The class is every year becoming more efficient in spite of the slurs thrown upon them by certain reports.

Who are the men that will be called on to hold the throttle of our modern flyers? It is not going to be the oldest man in all cases, unless he is up to the standard. It is no place for the old man in his dotage, a young man in his nonage, a nervous or a reckless man. It requires a clear cool head head with good judgment and keen sight, a man of nerve.

Concerning the Cipher.

How strange it would seem to be without a cipher in our notation, yet there was a time when this useful sign was wanting. The Roman system had no zero, nor did the Arabic, until the year 813. It was not until the fifteenth century that the Arabic numerals came into general use in Europe, and, like all innovations, it was resisted. Another strange thing is that while the 1, 3, 5, 6, 8, 9 and 0 are about the same now as in the thirteenth century, the 2 and 7 have undergone great changes. The 2 looked like a crooked 7, the 7 like an inverted A, and the 4 somewhat resembled the 5.

Railway Men's Wages in Germany.

We notice that a newspaper correspondent located in Berlin makes the statement that the railway employes of Germany are particularly zealous to be assigned to army employment. This is no matter for surprise since the average yearly wages of German railway employes is less than one dollar a day. For laborers and others engaged on work requiring little skill the pay seldom exceeds 50 cents a day and many hard working persons receive only half of that sum.

Address Delivered by Mr. W. R. Scott

Vice President and General Manager of the Southern Pacific Company Before Convention of American Association of Railway Superintendents, Held at San Francisco

Less than 100 years ago there were no railroads in this or any other country on the globe. It was in 1824 that the prospectus of the Liverpool and Manchester Railroad was issued in England for a "general railroad business." Strangely enough, in the same year a line was proposed from Baltimore to the Ohio, and a plan for a road from Philadelphia to Pittsburgh, which was pending before the Pennsylvania legislature, was approved.

In 1826 a line of wooden rails on granite sleepers was constructed out of Quincy, Mass., to extend three miles to some granite quarries at Neponset.

In 1827 Baltimore became agitated over the completion of the Erie Canal and the prospect of New York and Philadelphia dividing the business between them, threatening the commercial importance of Baltimore. In the same year nine miles of the Mauch Chunk Railroad were completed.

In 1828 the Baltimore & Ohio, which was the pioneer railroad in America, decided on their location along the valley of the Patapsco and thence to Point of Rocks on the Potomac. The ceremony of laying the cornerstone and beginning the work was held on July 4, of that year, and Charles Caroll, the last surviving signer of the Declaration of Independence, was invited to lay the stone. In 1830 the line was opened for operation to Ellicott's Mills, a distance of fourteen miles.

There appears on the editorial page of the *American* of January 5, 1831, the following:

"The Baltimore & Ohio Railroad, being desirous of obtaining a supply of locomotive engines of American manufacture, offers to pay $4,000 for the most approved engine and $3,500 for the next best, to be delivered on or before June 1, 1831. Engines to burn coal or coke and consume their own smoke. Must not weigh to exceed 3½ tons and on a level road to haul 15 tons weight, inclusive of weights of wagons."

I quote the specifications so that suitable comparison can be made with the locomotives and trains of the present day. The competitors in the builders' test were five in number, most of them being watchmakers. The first prize was awarded to Phineas Davis, a watchmaker, of York, Pa.

During the same period the Mohawk & Hudson (part of the New York Central) was also being constructed, the "De Witt Clinton" being the first locomotive to run on that line on August 9, 1831. Therefore, this year can be said to usher in the beginning of American railroads and the American construction of locomotives. Construction was active. In 1832 there were 67 roads, varying in length from 100 yards to 22½ miles, in operation in Pennsylvania, the first Baldwin locomotive was also built in that year.

In the early days, the "manager" (called on some lines the "superintendent of the road") was in active charge of all matters, including the construction and operation of the line. Equipped with tools of clumsy design, whose nature the wisest only half understood, with no precedents but those of energy, judgment and hardihood, to act as guides, sundered from his brothers in the profession by tracts of forest or mountain, he was at once adventurer, discoverer and conqueror.

The small beginning of that day was [illegible] degree of originality, self-reliance and courage which this generation can hardly appreciate. Added to the mechanical and business problems which sprang up in the path of the new institution was a problem in organization which was peculiar to its own time. That was an age of adventure. His individuality was that of the alert, resourceful man, very capable of taking care of himself and very insistent upon the privilege of doing so. That independence of spirit, impatience of restraint and resentful of authority, splendid in itself was at the same time an obstacle to efficient organization as real and as potent as were mountain and stream to the construction engineer.

[illegible]

In the early decades of railroading it was no mere figure of speech to refer to the superintendent as the ruler of a principality. He was in brief the epitome of the operated railroad. The promoters, the owners or the builders, as the case might be, gave the railroad over to his care. Its weal or woe was henceforth in his keeping. Track, engines, cars and train movements were in his charge, to be sure, but so also income accounts and traffic, and there was no law department to tell him "Thou shalt not." His accounts were simple, merely those sufficient to reflect the results of his stewardship. It is questionable if we do much more with the expensive and elaborate accounting system of today. Perhaps, compared with the confusion of today, his traffic troubles were simple. True, his territory was small, his commodities few and his competition limited. On roads like the Quincy, the Mauch Chunk and the Delaware & Hudson, his road was intended only for one kind of traffic. But roads like the Baltimore & Ohio, the Pennsylvania Lines, and the Charleston & South Carolina, were from the first designed for general traffic, and almost from the first the usual forms of competition by team, canal and river were manifest. If these competitors were crude, so also was the railroad crude, and the superintendent met the conditions as circumstances required. So it is of record that the Baltimore & Ohio, somewhere about 1837, reduced its rate on wheat into Baltimore from $2.50 per ton to $1 per ton at points which were also touched by the Chesapeake & Ohio Canal.

Poverty, panic and civil war combined to make more than a generation pass before the growth of railway systems put them beyond the power of one man to rule in that intimate, comprehensive way which had been the manner of the superintendents of the first railroads. The movement toward consolidation of short connecting lines into systems was well started before the Civil War. The Pennsylvania, the Erie and the Illinois Central had grown beyond the limits of an operating division, but with the war ended it was as if a dam had been removed from the channel of a stream. The rush of building and consolidation was accompanied by marked changes in railway organization.

An interesting transition phase is shown by the Pennsylvania in 1852, the year that the road reached Pittsburgh. Four departments were provided—Construction, Transportation, Auditing and Treasury. Under the superintendent as the head of the Transportation Department were two assistants, in charge respectively of road and branches, and of rolling stock, and a third assistant whose duties were "to con- [illegible]

[illegible] the line [illegible] keeping permanent records of such contracts and [illegible] a general freight agent and a general ticket agent, with powers to regulate prices for [illegible] to and from Philadelphia and Baltimore. The "toll sheet," corresponding in purpose to the present day tariffs, was adopted by the board of directors. When a change became necessary in the toll sheet the general freight agent was empowered to [illegible] the needful arrangements with the connecting roads. [illegible] the superintendent was the traffic manager throughout his division, except in two terminals. Inter-company relations, which had now grown numerous, were being handled by the head of the company, the president, through an assistant, the general freight agent or general ticket agent

The Illinois Central in 1858 shows a similar transition stage, though a slightly different form of organization. The Illinois Central at that time had two divisions, the Northern and the Southern, each under the jurisdiction of a superintendent, who was responsible to the master of transportation, Mr. Clarke. As a report of that date reads: "The entire regulation of the traffic of the company is entrusted to Mr. Clarke." The departments under him consisted of the master of machinery, Mr. Hayes; the general freight agent, Mr. Forsyth; the general ticket agent, Mr. Johnson; the purchasing agent and the conductors. The Illinois Central had not departed in principle from the idea of general control by the operating department. The Pennsylvania had recognized in part a line of cleavage between traffic functions and operation. This line of cleavage developed rapidly into a distinct separation of these two branches of railway activities during the late 60's and early 70's.

It may be said, then, that the superintendent of the past reigned for about thirty years, from the beginning of the roads in the early thirties up to the early sixties. The superintendent of the present can be said to have occupied the place from that date to the present time, although there has been a material change in the administration of affairs on the [illegible] compared with the period from 1866 up to that time. Between 1866 and 1888 the [illegible] about the details of traffic and the segre- [illegible] proposition the country was improving and developing everywhere; rates were [illegible] and in 1888 was about 152,000. But in 1888 there was a sudden arrest of railroad development. A period of liquidation set in, covering several years, which for the first time called attention to the necessity for retrenchment and economies in the operation of the service in every direction. The western roads suffered the most because of the sparsely settled country that they served. Several of these roads made such a wonderful financial showing notwithstanding the decreasing business that the attention of owners of Eastern lines was attracted, and they investigated the economies that had been effected on the Western roads and made calculations on what the showing would have been on the Eastern lines had the same economies prevailed. As a result several of the men who had been prominent in the management of Western roads were transferred to the East.

Since that time there has been a gradual tendency towards lower net revenues by reason of the assaults on the rates of the carriers before commissions, State and Interstate, and with the constantly increasing expenses and the high cost of living of the railroads the superintendent has had to deal principally with economies in operation. That he has responded to the demand is best evidenced by the results obtained on practically all of the railroads in the United States as reflected in their annual reports. And the work has been particularly trying during the past five years.

With the general establishment of traffic departments competition took on some new aspects. Here was a body of men within the service, the sole measure of whose efficiency was the gross tons and gross revenues of the company. They could not be measured by net revenue, for they did not have control of the subtrahend — the operating expenses. The natural result was that rates ceased to reflect the worth of the service to the patron, but rather the necessities of the traffic officer to make a showing. Railway accounts were analyzed in strange, new ways, and ingenious theories came forth to justify rates so low as to excite the apprehension of boards of directors.

With amazing penetration the shippers swiftly detected this weakness in the railway position. Long before the real elements of truth in the theory of subnormal costs were appreciated, firms, industries, whole cities, even, descended upon the luckless rate makers, each ready to show why the subnormal rate should apply to him, each with his threat rehearsed should his argument be insufficient, and each knowing that his threat could be made good. Then ensued an era of intrigue and deception. Freight agents deceived the merchants and the merchants deceived the freight agents. The hint of a cut in rates on a rival line, dropped pur- [illegible] reach the ears of a freight agent. His nerves being strained to the breaking point to detect such moves in advance, his suspicions would seem confirmed. None so credulous as he, the result of this "inside tip" would be an actual cut, made in secret, but soon public property because of the visible evidences.

I will not say that any set of men were personally to blame for this condition, or that rate matters could have been left under the jurisdiction of operating officials, or that if they had been so left those officials would have refrained from the practices I have just reviewed, because of the methods then in vogue for making rates and meeting competition. In fact we know that superintendents did not refrain entirely when it was within their power to do so. If our early railroads had adopted the plan of the roads in Great Britain the business complications that became common in the United States would have been prevented. In Great Britain a regular schedule of rates for both freight and passenger was established by the management under Government supervision and no deviation from that schedule was attempted. I have never heard of rate cutting on European railways.

The first pools failed because the traffic men distrusted each other too deeply. Those which were finally successful were made illegal partly because militant shippers, warned by the earlier attempts, were organized to defeat them.

Inherently much the same reasons exist to justify suspicion of each other on the part of the Master Car Repairers and Car Accounting officers as existed among the traffic men under the famous pools. As a matter of fact I guess we will all admit that these branches do have their troubles. But their confidence has never been completely undermined, and so the disturbances have been controlled. Their organizations are a success, millions of dollars are saved annually to the carriers, and in turn the public receives the benefit of a more convenient, more expeditious, more responsible service and at a charge far lower than would be possible without such operation.

Competition in rates is past, but that does not mean that competition is dead. There are two prime phases to the sale of transportation—the price charged and the service rendered. The first is fixed by law, the latter only is variable. Competition in service remains, and herein appears at once the opportunity and the responsibility of the superintendent. The duty of building up this service of a road falls very largely upon the division superintendent. This competition of service will represent something finer and higher than the usual things we have expected from struggles. It will not be secret and conspiring, seeking its ends by unfair means, but will be open and square

in the sight of all men. Its motto will bear no such brutish legend as "The survival of the fit." Its method will not be to kill the unfit, but rather to teach him how to be fit. Your association is one of the evidences of this form of competition. Scarcely a week has passed during this Exposition year in which one or more learned or professional societies have not gathered to exchange the fruits of their experience and to make the discoveries of one the property of all. Who can measure the benefits to us all which have sprung up from this attitude on the part of bacteriologists and medical men—for example? In the same way will a friendly business rivalry in your own profession redound, not only to the profit of the institution to which you belong, but also to the commercial public at large.

The orderly progress of the work demands that the railroad superintendent of the future be greater in his accomplishment than the superintendent of the present or of the past. New and complex problems will confront him and to him will be assigned the duty of satisfying the public. With the matter of rates handled and approved by government function, the existence of the present day traffic department—as such—will not be necessary, but it will be organized along different lines. We will have our rate bureaus for the purpose of assisting in hearings on rate matters before commissioners and tribunals and for the co-ordination of connecting lines for the proper division of rates, and we will have solicitors for traffic. Inasmuch as no favor can be given to shippers to induce traffic to travel by any particular channel, the only thing that will govern the securing and movement of traffic will be service in addition to solicitation, and service the most important of all. The superintendent is responsible for the service rendered and the cost of same, about 75 per cent. of the total expenses of railroads being disbursed under his direction. The solicitors for service, therefore, should be on the superintendent's staff, as he is the man charged with the responsibility of rendering the service and is in constant personal touch with the patrons of the line, and for this reason can best serve and satisfy them. Competition will be measured by the quantity and quality of the service rendered the public for the published price. As illustrative of my meaning, you and your predecessors have so trained your forces that the railroad travel on many lines is perhaps more safe so far as danger or risk of accident is concerned than is the ordinary life at home.

But there are other matters to be considered. Loss of freight between origin and destination; loss of freight at originating point due to improper marking or checking; damage to freight as a result of rough handling. These are constant drains on railway revenues. All such matters are within the superintendent's jurisdiction and correction of these defects and the rendering of perfect service will be the best advertisement that any railroad can have. And this, together with courteous treatment of the public by officers and employes, will be the determining factor in the railroad's popularity.

The superintendent of the future will probably see quite a change in the relation of government to railroads. It may take one of two forms. If the public is satisfied that the business of the railroads is efficiently and economically administered it is possible that additional earnings will be permitted to enable the railroads to make improvements and add the facilities that are so much needed to keep up with the growth and development of the country, as well as to overcome the constantly increasing expenses of the railways, which will continue through increased wage allowances and the increasing cost of materials. The other form would be government ownership if the public continues to be misled by politicians who insist upon harassing the railroads and clamoring for their further repression. This has had the effect of misguiding a good many railway employes and the tendency now is for presentation on their part of the choice of granting extravagant wage increases for a day's work or having the service paralyzed. If the latter policies are adopted it will do much to hasten government ownership of railroads. The superintendents of today can do more than any other set of men to counsel the great organizations of railroad employes along the lines of reasonable action, which in the end mean much, so much for their welfare. Much good has been done by these organizations in the past in controlling their men and improving the service of the railroad. But the most can be done by such treatment of the public and such service to the patrons that the last lingering resentment against railroads will be buried with the past.

From the railroad ranks have come some great men, great in the up-building of the country as well as ability in their chosen calling. You are worthy successors of a noble past and I have faith in your ability properly to shape your course so that the superintendent of the future will not fail.

The First Chinese Railroad.

Away in 1890 Li Hung Chang was a highly important personage in China, of progressive tendencies that were severely restrained by the conservative tendencies of the Chinese government. Li Hung Chang had visited Europe and was greatly impressed with what he saw, more particularly the operating of railroads. He was owner of extensive coal mines some distance from an ocean shipping station and the practice was to haul the coal loaded cars by mules. There was no railroad, so the loads hauled over the miserable roads were light.

When Li Hung Chang returned to China he prevailed on the Manderins ruling to consent to the construction of a 25⅝-inch narrow guage railroad from the mines to the shipping point, but strict injunctions were given against the use of steam locomotives. He brought along with him a Scots machinist and engineer named Mackenzie, who had had railroad experience in New Zealand. The business that Mackenzie was hired for was to find the cheapest means of moving the coal from the mines to the port of shipment.

Mackenzie had been only a few weeks on the ground when he concluded that such motive power was expensive, so being a good mechanic his mind wandered toward a locomotive. By carefully examining all the junk shops within reach he collected sufficient scrap to construct a crude form of locomotive. It was one of the most wonderful looking machines ever forced into use for railroad motive power, but it worked and hauled cars equal to the work of ten mules.

News travels slowly in China but it gets there in time, and the Mandarins in Pekin learned that the foreign devils were using a fire-eating monster on the railroad, so they proceeded to make it hot for Li Hung Chang, who professed ignorance of what had been done. He ordered the operation of the rattle trap locomotive suspended for a time, but when the public alarm subsided ordered two real locomotives from a company in Glasgow.

Testing Steel.

To test hardening qualities, draw under a low heat to a gradually tapered square point and plunge into cold water. If the broken point will scratch glass the quality is good. To test tenacity, a hardened piece may be driven into cast iron by a hardened hammer. If poor, it will be crumbled. Soft steel of good quality gives a curved line fracture and uniform grey texture. Good tool steel will fall to pieces at a white heat, will crumble under the hammer at a bright red heat, and at middling heat may be drawn to a needle point.

Very Trying.

"Well, that's enough to try the patience of Job!" exclaimed the village minister [illegible] what's the matter, dear?" asked his wife. "Last Sunday I preached from the text [illegible] good man, but the printer makes it read, 'Be ye there for breakfast.'"

Electrical Department

Interesting Incidents in the Development of Electric Science

At a recent meeting of the Pittsburgh Railway Club, the [illegible] scientist, Dr. John A. Brashear, talked on Evolution of Science, giving personal reminiscences that read like an Arabian Nights entertainment. We have been ambitious to present that talk to our readers but it contains about 8,000 words which would fill four pages of RAILWAY AND LOCOMOTIVE ENGINEERING, so we are compelled to present it in sections. Dr. Brashear said:

Come with me now into the domain of electrical science, with which I have been in a measure so long associated, though of course not in all its phases. I can remember very well when I was about six years of age that my grandfather made a very beautiful little engine driven by electricity gotten out of the acid action upon copper and zinc in the old-fashioned Burneen battery. When I was in Nyland in 1888 I was the guest of my friend then Dr. Dewar, who has since been knighted. He one day took out of the holy of holies a little coil about one foot in diameter, covered over with a belt of muslin that had become worn and was quite ragged, but they did not like to change it at all because it was so precious. Laying it in my arms he said, "Brashear, what do you think that is?" I said, "Whatever it is, it is a mighty crude piece of apparatus." "Don't say that about it, that is the father and the mother of all the dynamos and motors and electric light and electric energy of to-day." And that little coil made by Faraday was kept in the little room like a precious gem, because of its wonderful historic value. This is one of the things we Americans are lacking in. We let our historic munitions go by the board until it is too late to save them.

When my friend took out of the same sacred place, the little lamp made by Sir Humphry Davy, the safety lamp for fire which has been developed so wonderfully since, and put it in my hands, and then [illegible] I felt like a prince to have such a privilege. Most of us have seen the marvelous development in electrical science. We have seen it in so many ways, particularly in the domain of that which is so valuable and so necessary in your own line of work. Let me tell you a little story which you will enjoy. I was a member of the American Association of Science, in the department of astronomy and physics, when we were invited to Terre Haute, I think about 1889. We were given a luncheon at the Polytechnic Institute, where Mr. Thompson who was Secretary [illegible] was asked to make a speech. He got up slowly and reluctantly and said, "I do not know what I am going to say among a lot of scientific men like you, but I will tell you a story. In 1844 I was a member of Congress from this district. There were only two or three of us for the state at that time. When we went to Washington we went part of the way on horseback, part of the way by stage coach, part by canal, and when we got up to Cumberland we took the little railroad. We usually planned to go to New York before we went to Washington. Well I was sitting in the hotel just after we got to New York when a gentleman from Massachusetts came to tell us, there was a gentleman across the street named Morse, who had an instrument he called an electric telegraph, who says he can send a message from Washington to Baltimore in less than two seconds, and he wants to get money from Congress to lay a wire so he can send messages. Well Thompson said I was a farmer and didn't know anything about such things. But he pleaded with me and the next day we went over to see Morse and found him sitting at a table and a number of gentlemen standing around. He was exhibiting a machine with a little roll of paper tape coming out of it covered with dots and dashes. After we were introduced and the other gentlemen had gone away he told us he had ten miles of wire in the house through which he was sending his messages. After describing it he said, "Mr. Thompson, if you will ask me a question I will try to answer it on this machine. Henry Clay and James K. Polk were running for the presidency at the time and do you know what I asked him?" I asked him "Who will be the next President?" He put down the key and tapped and after a little the ribbon came out and he picked it up and it read, "Henry Clay." Do you know what I told him? I told him I didn't know anything about the machine but I liked its politics and I would vote for it. The conclusion of the matter was this Congress voted him a $25,000 subsidy to lay the line between Baltimore and Washington. I voted for it; my col[illegible] voted for it and the act was passed. But at the next election for Congressmen in my state I got through by the skin of my teeth and my colleague was defeated "for wasting the public money."

You may know the disappointment, when Morse had laid his line only about half way he lost his signals. They did not know so much about induction in those days as we do now. I got the remainder of my story from Dr. Gardener Hubbard the father-in-law of Graham Bell. Morse went to Cornell and said, "I can't get my signals, and all my money is gone. I should have put it on poles." Mr. Cornell said, "Go ahead I will get the money for you." It was finished, and one of the first records that came through that wire was the announcement of the election of the President of the United States, but it was not Henry Clay. Thus Ezra Cornell saw that the line was completed on to Philadelphia and New York, and you all know the subsequent story of the electric telegraph.

Only fifteen years ago I sat at the table with my friend, the greatest physicist I think that ever lived in the United States. Prof. Henry A. Rowland, of Johns Hopkins University, where there were four girls sitting at four typewriters sending four messages over one wire in one day, and I was told there were four at the other end sending four messages the other way over the same wire.

And now look what the wireless is doing. You know that up at the observatory we are trying to keep the time within four or five seconds a year for the Pennsylvania railroad. I am proud to say this is where standard time was first started by our friend Langley in 1879, where he had 4,300 miles of railroad connected up with our time service. We give you the time with one of our list clocks within four tenths of a second for the entire year. But now comes in the wireless—I took up the receiver at the National Observatory only a few weeks ago and listened to the ticking of a clock over 500 miles away and now they are making efforts at Washington to hear the ticking of the clock in the Paris observatory. We have not yet signaled around the earth but it will be done and some of you will live to see it.

Kindred advance is shown on every form of electric energy. And what does electric energy mean? It is simply the stored up energy of the sun stored up years ago. We are taking the carbon that was stored in the coal fields and shoveling it into our boilers and transferring it into steam and putting that into the engine and bringing it back in the form of energy. And some day, though you and I may not live to see the day, we will utilize the energy of the sun direct. For do you know that there is one horse power per hour from the sun for every square meter—and that is a little over a square yard—of the surface of the earth when the sun is shining, all going to waste now. Some day we are going to utilize it. Not all of it is going

to waste now, because the sun lifts the water from the ocean deposits it on the land in rain that runs into the Great Lakes there over Niagara and turns the wheels of the power houses so that we do get some of it back second hand. So that electric energy from that small commencement away back in the days when Volta put the zinc and the copper plates together have developed into these wonderful things of today.

I once told that story of the telegraph in the presence of Dr. Gardener Hubbard who was an inspiration to his son-in-law Alexander Graham Bell in the wonderful development of the telephone. He told me that the first person who listened to the telephone after its experimental stage was Sir William Thompson, afterwards Lord Kelvin. He informed me he had stretched his wires through the exposition building in Philadelphia and wanted Kelvin to hear the message first. Kelvin was at one end ten or fifteen miles of wire away from Bell. When they were ready Kelvin put the receiver to his ear and Bell at the other end sent the message. Hubbard said Thompson dropped the receiver and said "My heavens, the thing talks." You know what has been developed in this wonderful instrument since that time until we can do almost anything over the telephone except swear."

The Wee Motor.

The encroachment of the Jitney on the railway field led to the study of the broad problem of transportation and the conclusion reached by those in a position to know was that there would undoubtedly be a demand at an early date for a light weight car, of from 8,000 to 12,000 pounds completely equipped without load with possibly one-man operation.

A car of this weight, would have, depending on the design, a seating capacity of from 24 to 30 passengers, and would meet the requirements of most operating companies during light load periods, and practically all requirements of those in cities of 100,000 population or less.

The economies of a light weight car are numerous since they involve power consumption per average passenger hauled, track maintenance, brake-shoe and wheel wear and, above all, platform expense as one-man operation is frequently possible. The larger number of cars that can be purchased for the same amount of money permits more frequent service for a given investment, and also faster schedules are possible, due to fewer stops made with frequent headway.

The public, as a rule, appreciates rapid and frequent service, and such properly advertised would unquestionably be more attractive than the Jitney.

The Westinghouse Electric & Mfg. Co., realizing the necessity for a motor to fulfill the requirements of light-weight car operation, made a thorough investigation of the requirements which would have to be met under the varying conditions, and developed an entirely new motor of light weight, yet rugged construction to properly perform such service, thereby maintaining its position as a pioneer in the railway field. It would have been possible to modify existing designs of industrial or electrical vehicles for this service, but the Company, recognizing the fact that small car operation would come to stay and only be successful if a motor designed to meet the specific conditions would be applied, went to the expense of developing and building the No. 505 railway motor, popularly designated as the "Wee" (Westinghouse Electric Efficiency) motor.

This motor has a rating of 17.5 h. p. at 600 volts, and weighs, complete with gears, gear case and axle bearings, 800

THE W[illegible]

pounds. It is the lightest weight motor for railway service ever placed on the market.

The design includes all of those features which have proven so successful in larger sized motors which have been on the market for some years, only such changes being made as are necessary to adapt it to the service requirements.

The Corpus Christi (Texas) Street Railway Company was pioneer in working out this problem, and ascertaining the availability of the Wee Motor, purchased eight double equipments for immediate delivery to perform the following service:

The Company operates a city line three miles long, and the car weighing 14,000 pounds is to make eight stops per mile, with a maximum speed of 30 miles per hour.

The Albuquerque Traction Company, Albuquerque, N. M., also purchased seven double equipments of this motor, for city service. The car, weighing 11,800 pounds and seating 28 people, will have a schedule speed of 9 miles per hour with 8 stops per mile.

The Rio Grande Railway Company, Brownsville, Tex., was adapted to single equipments of No. 505 motors. The existing road is operated by mules and it will be noted that one of the "Wee" motors will satisfactorily perform the service required, and in this case it is said a special economy will be effected in view of the elimination of the mule's kick.

It seems reasonable to predict that this new motor will make a record equal to that of the well known No. 101-B motor, "the father of them all!"

Westinghouse Electric Awards.

The Westinghouse Electric & Manufacturing Company announces the following more important among the large number of awards received at the Panama-Pacific International Exposition: The Grand Prize, the highest possible award, on the 4,000-horsepower, 650-volt, direct current double-unit Pennsylvania electric locomotive mounted on a turntable under the dome of the Transportation Palace. The Medal of Honor on alternating current and direct current industrial motors and control apparatus, on precision instruments, on Le Blanc condensers, on motor-generator sets for moving picture machines and on high voltage oil switches. [illegible] classes of apparatus, among which are steam turbines, alternating and direct current generators, alternating current and direct current railway motors, transformers, rectifiers; starting, lighting and ignition systems, switchboards and accessories, and mining locomotives. A number of silver medals and bronze medals were also received. The Westinghouse Electric & Manufacturing Company was also awarded the Gold Medal for the most complete and attractive installation in the Palace of Transportation.

Troublesome Curfew.

Tom Ruskin is a native of Springfield and belongs to one of the best families. On finishing at the high school he entered the principal dry goods store. After a couple of years behind the counter, Tom declared the life was too dull and started out to see the world. He struck a job on the Erie as brakeman and took [illegible] man and is still wielding the scoop. Last [illegible] to see his friends in Springfield [illegible] asked: "What's come of the curfew whistle?" "Well," answered the mother, [illegible] o'clock and wakened half of the people, so they complained and had it stopped and we can sleep now."

Items of Personal Interest

Mr. [illegible] has been appointed master boiler maker of the Pennsylvania, with office at Columbus, Ohio.

Mr. A. M. [illegible] has been appointed general car foreman of the Illinois Central, with office at Memphis, Tenn.

Mr. J. C. [illegible] has been appointed chief engineer of the East & West Coast, with headquarters at Bradentown, Fla.

Mr. Joseph Wendel has been appointed valuation engineer of the Santa Fe System, with headquarters at Chicago, Ill.

Mr. Frank H. Hagan has been appointed assistant roundhouse foreman of the Santa Fe, with office at Gallup, N. M.

Mr. C. White has been appointed roundhouse foreman of the National Transcontinental, with office at Edmundston, [illegible]

Mr. R. J. [illegible] has been appointed engineer of the Panhandle division of the Santa Fe, with headquarters at Wellington, Kans.

Mr. J. W. Foizey has been appointed assistant master mechanic of the Chesapeake & Ohio, with headquarters at Newport News, Va.

Mr. T. A. Albright, formerly foreman engineer of the Texas & Pacific, has been appointed road master mechanic, with office at Marshall, Texas.

Mr. A. J. Devlin has been appointed traveling roundhouse foreman for the St. Louis and San Francisco, with headquarters at Springfield, Mo.

Mr. J. A. Miller has been appointed locomotive foreman of the Grand Trunk Pacific at Endake, B. C., succeeding Mr. G. H. Laycock, transferred.

Mr. Charles Edelman has been appointed signal supervisor of the Missouri Pacific, with office at Asawatomie, Kans., succeeding Mr. A. Dewey, resigned.

Mr. [illegible] has been appointed chief dispatcher and division operator of the Pasco division of the Northern Pacific, [illegible] Wash.

Mr. R. M. Boldbridge has been appointed master mechanic of the Apalachicloa Northern, with office at St. Joe, Fla., succeeding Mr. J. P. Dolan, resigned.

Mr. W. H. Owens, master mechanic of the Southern at South Richmond, Va., has been appointed mechanical member of the valuation department of the Southern.

Mr. J. H. Moore has been appointed with headquarters at East Salamanca, N. Y.

Mr. F. K. Bennett, formerly supervisor of the Minneapolis & St. Louis at Monmouth, Ill., has been appointed valuation engineer, with office at Minneapolis, Minn.

Mr. J. E. Willoughby has been appointed chief engineer of the Atlantic Coast Line with headquarters at Wilmington, N. C., succeeding the late Mr. E. B. Pleasants.

Mr. B. C. Tracey has been appointed supervisor of electric welding of the Baltimore & Ohio, with jurisdiction over this work in all shops on the system, with office at Baltimore, Md.

Mr. S. C. Eastman, formerly manager of the Chicago office for Pratt & Whitney Company, has been appointed manager of the company's new office and show room at San Francisco, Cal.

Mr. J. P. Nelson, member of the valuation committee of the Chesapeake & Ohio, and the Chesapeake & Ohio of Indiana, has been placed in charge of the engineering work of the committee.

Mr. W. W. Warner, formerly general foreman of the Erie car shops at Marion, Ohio, has been appointed general foreman of the steel car repair shops on the same road with office at Cleveland, Ohio.

Mr. W. F. McDade, formerly draftsman of the Mobile office of the Southern, has been appointed acting division engineer of the Southern in Mississippi, with headquarters at Columbus, Ga.

H. M. Powell, recently general storekeeper of the St. Louis & San Francisco, has been appointed to the newly-created position of supervisor of material and supplies of the Texas & Pacific, with headquarters at Marshall, Tex.

Mr. W. D. Pearce, formerly assistant engineer of the Northern Pacific, has been appointed supervisor of bridges and buildings on the Yellowstone division of the same road, with headquarters at Glendive, Mont.

Mr. John McRea, formerly shop foreman of the Canadian Pacific at Kamloops, B. C., has been appointed locomotive foreman on the same road, with office at North Bend, B. C., succeeding Mr. C. Brown.

Mr. D. L. Clough, master mechanic of the Oregon electric railway, and the United Railways Company, at Portland, Ore., has had his jurisdiction extended to include the Spokane & Island Empire Railroad.

Mr. [illegible] has been appointed engineer of tests of the Chicago, Milwaukee & St. Paul, succeeding Mr. W. F. Lynaugh, who has accepted a government position in connection with the valuation of railroads.

Mr. Samuel H. Reams, for the past six years agent of the Seaboard Air Line at Savannah, Ga., has been made Vice-President and General Manager of the Durham & Southern, with office at Durham, N. C.

Mr. J. E. Lloyd has been appointed division engineer of the Baltimore & Ohio, with office at Cleveland, Ohio, and is succeeding Mr. L. W. Strayer appointed division engineer on the same road, with office at Garrett, Ind.

Mr. Robert M. Smith, formerly assistant mechanical engineer of the Acme Supply Company, Chicago, has been appointed mechanical engineer. Mr. Smith was formerly in the employ of the Illinois Central as draftsman.

Mr. C. D. Perry, formerly assistant road foreman of engines of the Delaware & Hudson, has been appointed road foreman of engines with office at Oneonta, N. Y., succeeding Mr. O. E. Ackart, assigned to other duties.

Mr. R. L. Chandler, formerly general piece work inspector on the New York Central lines, has been appointed district master car builder on the same road with office at East Buffalo, N. Y., succeeding Mr. W. O. Thompson, promoted.

Mr. P. Linthicum, formerly assistant superintendent of shops at Silvis, Ill., has been appointed acting master mechanic of the Missouri division of the Chicago, Rock Island & Pacific, with offices at Trenton, Mo., succeeding Mr. E. J. Harris.

Mr. E. J. Harris, formerly master mechanic of the Chicago, Rock Island & Pacific at Trenton, Mo., has been appointed acting master mechanical superintendent of the second district, with offices at Topeka, Kans., succeeding Mr. G. W. Lillien, resigned.

Mr. J. E. O'Brien, formerly assistant mechanical superintendent of the Missouri Pacific and St. Louis, Iron Mountain & Southern, has been appointed mechanical superintendent of the same road, with offices at St. Louis, Mo., succeeding Mr. R. I. Turnbull, resigned.

Mr. R. D. Starbuck, formerly special engineer on the staff of Mr. J. J. Bennett, vice-president of the New York Central at Chicago, has been transferred to New York as special engineer on the staff of Mr. A. T. Hardin, vice-president in charge of operations at New York.

Mr. C. A. Parker, telephone maintainer

of the Buffalo, Rochester & Pittsburgh, has been appointed signal supervisor of the Middle and Pittsburgh division, with headquarters at Du Bois, Pa., and Mr. J. H. Moore, formerly general signal foreman, has been appointed signal supervisor of the Buffalo division, with headquarters at Salamanca, N. Y.

The following are the new officials of the Atlanta & St. Andrews Bay Railway: Asa G. Candler, Atlanta, Ga., President; R. A. McTyre, formerly President of the Greenville & Western and Secretary to ahe President of the Georgia, Florida & Alabama, Vice-President and General Manager; W. H. Leahy, lately Traveling Passenger Agent of the Nashville, Chattanooga & St. Louis, General Freight and Passenger Agent.

Mr. W. O. Thompson, formerly district master car builder of the New York Central at East Buffalo, N. Y., has been appointed superintendent of rolling stock

BENJAMIN G. LAMME

for the lines west of Buffalo, with offices at Cleveland, Ohio. Mr. Thompson's appointment has been warmly approved by all who have the honor of his acquaintance. It may be recalled that Mr. Thompson has been for many years the Secretary of the Traveling Engineers Association.

Mr. J. J. Carey, formerly master mechanic on the Texas & Pacific at Marshall, Texas, has been appointed superintendent of shops at the same place, and Mr. F. W. Boardman has been appointed assistant to the mechanical superintendent, also with office at Marshall, Texas, and Mr. J. S. Schneider, formerly machine shop foreman on the Texas & Pacific at Marshall, Texas, has been appointed general foreman of the erecting and machine shop at Marshall.

Mr. A. H. Kendall and Mr. L. C. Ord have been appointed assistant works managers of the [illegible] the Canadian Pacific at Montreal, Canada, and Mr. M. Wells has been appointed general foreman on the same road, with office at North Bay, Ont., succeeding Mr. A. H. Kendall.

Mr. C. A. Welch has [illegible] roundhouse foreman [illegible], with office at Biddle, Ark. Mr. Fred Wallace has been appointed roundhouse foreman on the same road, with office at Trenton, Mo., and Mr. John Datnoe has been apointed fuel inspector on the same road, also with office at Trenton, Mo.

Mr. Benjamin G. Lamme, Pittsburgh, who has been appointed by Mr. Daniels, Secretary of the Navy, as a member of the Naval Advisory Board, is a native of Ohio and a graduate in mechanical engineering from the Ohio State University. In May, 1889, he entered the employ of the Westinghouse Electric & Mfg. Company in their Testing Department. Soon afterward he took up design work which he has followed continuously since. In 1900 Mr. Lamme was made Assistant Chief Engineer succeeding to the position of Chief Engineer in 1903 which position he now holds. He has been a leader in the development of alternating current apparatus including the induction motor, polyphase generators, rotary converters and single phase railway apparatus. He has also been a pioneer in the development of first direct current apparatus for railway lighting and power work. As an electrical engineer, Mr. Lamme is known the world over, and is an exceedingly fertile inventor, having to his credit a very large number of important patents covering electrical apparatus. One of his duties at the present time is the chairmanship of a committee of the Westinghouse Electric & Mfg. Company which passes on the value and application of various inventions which are brought to the attention of the Company.

He is a member of the American Institute of Electrical Engineers and has contributed to that body a large number of valuable technical papers. Mr Lamme's writings are noted for their clearness and freedom from mathematical complications, he having acted for some years past as chairman of the Board of Editors of the Electric Journal. Among the more prominent installations with which he has been identified may be mentioned the famous 5,000 H. P. revolving field Niagara Falls generators, installed in 1895, the design of single phase motor and generator equipment for the New York, New Haven & Hartford Railroad, the Philadelphia-Paoli electrification of the Pennsylvania Railroad, and numerous other installations of importance. The new duties conferred upon Mr. Lamme will not interfere with his work with the Westinghouse Company.

Sir William Van Horne.

The death occurred in Montreal on September 11 of Sir William Van Horne, one of the most prominent of Canadian railroad men, at the age of 72. The de- [illegible] for the speedy construction and successful development of the Canadian Pacific Rail- [illegible] and occupied the position for 11 years, resigning to become chairman of the board of directors, in which capacity he served until 1910. He remained a director of the company until his death. It has been said that to have built the Canadian Pacific Railway was a greater achievement than the building of any other railway had ever been, and a greater achievment than any future railway on this continent can be. For he built through an unknown, untried land; he had to be prophet as well as pioneer; seer as well as general.

EDWARD M. GROVE

The death is announced of Mr. Edward M. Grove, for many years associated with the McConway & Torley Company, Pittsburgh, Pa. Mr. Grove began his industrial career as a printer in Philadelphia in the early fifties. In 1876 he became telegraph operator, and was appointed district superintendent of the Pullman Company, and in 1886 he became assistant general manager of the Wagner Palace Car Company, with offices in New York. He became associated with the McConway [illegible] was elected treasurer of the company. Mr Grove was closely identified with the Railway Supply Men's Association for many years, and occupied the position of president for the years 1910 and 1911. Mr Grove was in his seventy-eighth year. [illegible] many qualities.

Andrew Carnegie's Compliment to Angus Sinclair.

Some years ago a [illegible] was held commemorating the founding of the Chambers Institute. Dr. Andrew Carnegie delivered the inaugural address. The great fiancier, who had a subject after his own heart, with enthusiasm and dramatic force drove home the lessons of independence, perserverance, industry and personal well-doing which led to business success in the career of William and Robert Chambers. Twenty-five years later than Dr. Chambers, Dr. Carnegie had founded a similar institute at Pittsburgh, the precursor of other unprecedented gifts of libraries and endowments for scientific and educational purposes all the world over.

Dr. Carnegie admitted that it was a delightful surprise when he heard of the Chambers Institute and found the pioneer a brother-Scot. In the course of his address he made the kindly reference: "It says much for the work of the two brothers and their descendents now in charge, that *Chamber's Journal* continues to occupy the proud place which, as pioneer in the field, it so rapidly won and that it is still in the family and still *Chamber's Journal*. The publications of the firm, as a whole have no rivals, either in Scotland or elsewhere."

Dr. Carnegie received many letters concerning his address and a selection of them was published by *Chamber's Journal* people. The first of these was from Dr. Angus Sinclair, of New York, who in his career presents another object-lesson on the lines of the address. His father was a railway man when Angus was born, in Forfar, but the son was raised in Laurencekirk, which was long celebrated for having excellent schools. Angus began railway work in the Laurencekirk office, where he became an expert telegraph operator. Owing to his skill in this art he was sent to the headquarters of the mechanical department at Arbroath as telegraph clerk, his father having arranged that he should learn the machinist trade after being two years in the office. He went through the machine shop course and drifted afterwards into train service, firing and running locomotives for a few years. He then passed an examination for the Civil Service and performed Customs duties in Montrose and London for a few years; but getting tired of that monotonous occupation, went to sea as a marine engineer. Two years later he emigrated to the United States [illegible] of Iowa City. Between trains on the latter [illegible] the Iowa State University, making water [illegible] management of this road sent a water inspector to Iowa City to arrange for providing a water supply. The expressed intention was to sink a well and erect a water tank. Mr Sinclair took water out of a creek by means of a steam syphon. He advised the water inspector not to put down a well as it was a Devonian limestone region that produced extremely hard water.

The inspector returned to Cedar Rapids and reported to the president of the road the facts he had learned about Iowa City water. On hearing the story, Mr. C. J. Ives, president, said: "If that man Sinclair knows as much about water as you say he does, we want him here. Hard feed water is the bane of this company."

Another engineer was sent to relieve Mr. Sinclair next day. He had a long talk with Pesident Ives which resulted in his being appointed chemist of the company. His principal duties in this position were the supervision of water for boilers. When not so engaged he ran a locomotive or acted as engine house foreman or assistant to the master mechanic.

Having a leaning towards literary work, Mr. Sinclair became a contributor to various scientific and railway publications, which brought him offers from different editors for steady employment on their journals. He finally accepted an offer from the American Machinist Publishing Company, and in 1883 left railroad work to become associate editor of the *American Machinist*. He has been engaged in technical journalism since that time and is now proprietor and publisher of RAILWAY AND LOCOMOTIVE ENGINEERING, one of the most popular publications in the world. He is author of several engineer works, among them *Locomotive Engine Running and Management*, now in the twenty-third edition; *Combustion in Locomotive Furnaces*, which has been translated into Chinese. *Development of the Locomotive Engine*, and others.

In 1908 the trustees of Purdue University conferred upon Mr. Sinclair the degree of Doctor of Engineering.

The letter from Dr. Sinclair which Dr. Carnegie sent to the editor of *Chamber's Journal*, reads:

"My Dear Mr. Carnegie:—I have received so much enjoyment from reading your address on William Chambers that I regard it as my duty to tell you something about how much I have been personally indebted to the Chamberses.

"I began railway work as ticket and telegraph clerk at Laurencekirk Station when I was only thirteen years old, having received a very defective education. Two years later I went to be telegraph-clerk to the locomotive superintendent at Arbroath, with the agreement that I would be worked through the shops. After about a year I entered the boiler shop as an apprentice, then the machine-shop, with lots of breaks to do office-work. The first boiler-shop work I did was carrying the tool-box for Willie Laurie, a celebrated fire-box patcher. I remember on the first morning, when I was assigned to the boiler-shops, the men lounging about the gate waiting for the bell to ring began discussing the alluring subject of what they liked best to drink. All sorts of mixtures were discussed, when Laurie's preference was asked. 'Well men,' he said, 'When I have my option I prefer a glass of whiskey mixed with another glass of whiskey.'

"That was my first mentor, and curiously enough he exercised a wonderfully good influence upon me. When we emerged from the first firebox we worked in, he asked, 'How many fire-bars are in that box?' Of course I could not tell, and he made me guess, jeering at my poor estimate.

"That was the beginning. Every job we worked on he had some questions to ask—the number of staybolts, the size of the different parts, etc., till I was forced to observe all kinds of details as a sort of self-protection. The habit of observing things grew upon me, and I have found it very helpful.

"My connection with the office brought me into contact with officials whom I believed to be perfect in engineering knowledge. 'How can I come to know theories of engineering?'—that became a burning question. There was an old dominie in Arbroath who kept a night-class for teaching sailors navigation. To him I went, and he wished to enrol me in his nevigation class. I steadily refused, and he conceived the idea that instruction in moral philosophy would help me. The result was that I devoted two winters to the study of Dugald Stewart's *Outlines of Moral Philosophy*. At the time I was getting discouraged over Dugald Stewart, I found a copy of *Chamber's Information for the People*. I went at once to the public library and examined the back numbers. Then I managed to subscribe for it. I began trying to study an hour every evening; but that was beyond persistence, and I finally settled down to twenty minutes every night, which was kept up for years. After a time I went firing, and was fearfully overworked, but I kept up my study of Chambers. I have come in after being out more than twenty hours on the engine, and when washing and preparing for bed did my twenty minutes of study. So you see that I have good reason for thanking William Chambers and his brother for part of the capital that raised me from the footboard to the editor's chair.

"I am ashamed of my long screed, but

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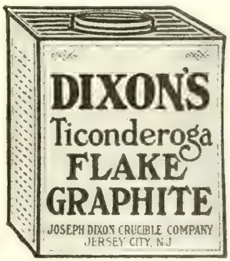

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[illegible]

Dr. Sinclair is a prominent member of several railroad and engineering organizations. He was for several years secretary of the Western Railway Club, then secretary for ten years of the American Railway Master Mechanics' Association, of which he has been treasurer for fourteen years. He is prominent in American-Scottish social and political organizations and has for years been president of the Scottish Home Rule Association.

What was the largest locomotive in the world a few years ago, owned by the Erie Railroad Company, is called the "Angus Sinclair."

National Tube Company Awards at the Panama-Pacific International Exposition.

The National Tube Company has received the Grand Prize, the highest regular award at the Panama-Pacific International Exposition, for the general excellence of its tubular products and fittings; the greatest merit being recognized in the following special products exhibited as representing the highest development of the art: "National" oil well casing, tubing, drill pipe, drive pipe, drill pipe and tubing with upset ends, line pipe, lead joint pipe, all manufactured in 40 feet lengths. Also Spellerozed pipe and boiler tubes, and steel poles. "National" protective coating, and "Kewanee" unions, valves and fittings. Also for "Shelby" seamless steel tubing, including special alloy steel tubing, boiler tubes, cylinder and flasks, steam pipe, drill pipe, mechanical tubing, trolley poles. It may be noteworthy of remark that there is only one Grand Prize in each class, and the National Tube Company received this award in connection with the above products. A number of other prizes and awards were made to the company and also a number of personal awards.

Gold Medal Award.

The Salt Lake Route-Union Pacific Building at the Panama-California Exposition at San Diego has been awarded a gold medal for the unique features of their building and the attractive displays therein.

The structure is known as the Salt Lake Route-Union Pacific Building, and was erected for the purpose of serving as an international transportation center and to provide information to world travelers and comfort to Exposition visitors. The building contains rest room for ladies and children, with maid in attendance, information bureau and telephone booths, smoking room for gentlemen and other accommodations. At either end of the main reception room large painted maps of the Salt Lake Route and Yellowstone National Park are shown on the walls with the exact topography of the country tributary. The entire front of the building is of glass transparencies showing the natural resources of the country traversed by the Salt Lake Route and Union Pacific System.

This is said to be the first building of its kind ever erected at any Exposition for a publicity exhibit. The special rest room provided for the entertainment of visiting railroad men is one of the prominent features. At the close of the Exposition the building will probably be donated for use of the Exposition Park officials.

A Correction.

In your issue of July, 1915, Page 220, you report that The New York Air Brake Company was awarded a medal of honor for its exhibit at the Panama-Pacific International Exposition, which is a statement that should be promptly corrected.

Kindly note that this was before the Superior Jury of Awards had determined what prize would be given The New York Air Brake Company, and we beg to request that you correct in your next issue the statement that we had received a medal of honor, and show that The New York Air Brake Company was awarded the Grand Prize for the "PS" Electro-Pneumatic Brake Equipment which it exhibited at this Exposition.

This decision by the Superior Jury of Awards giving us the Grand Prize was recently made and is the final official decision.

We shall, therefore, appreciate your courtesy in the matter, and remain,

THE NEW YORK AIR BRAKE CO.,
C. E. Leach.

Rumors About Baldwin Locomotive Works.

A rumor is current as we go to press that control of the Baldwin Locomotive Works has been secured by Charles M. Schwab of the Bethlehem Steel Company in combination with the DuPont powder interests. According to the Wall street talk the control of this immense property has been secured by purchase of the common stock in the open market. The rumored intention of the people purchasing the Baldwin Locomotive Works is to form a great manufacturing plant for the construction of railroad equipment, war munitions and general steel products.

The use of mechanical stokers for firing locomotives is making progress in most countries where railways are in operation, the principal aim being to reduce the heavy work of the firemen.

RAILROAD NOTES.

The Norfolk & Western Railway is in the market for 2[illegible] Mallet locomotives.

The Havana Central has ordered 1,500 tons of rail from the Bethlehem Steel Company.

The Interborough Rapid Transit has ordered 48[illegible] steel trucks from the Pullman Company.

The Maine Central has ordered 1,500 center constructions from the Standard Steel Car Company.

The Louisville & Nashville has ordered 43,000 tons of rails from the Tenessee Coal, Iron & Railroad Company.

The Utah Coper Company has ordered six 6-wheel switching locomotives from the Baldwin Locomotive Works.

The Butte, Anaconda & Pacific has ordered 100 50-ton ore cars from the Western Steel Car & Foundry Company.

The Ann Arbor has ordered 3 Mikado type locomotives, with 27 by 30-inch cylinders, from the Lima Locomotive Corporation.

The Atchison Topeka & Santa Fe Railway, it is reported, has contracted for 30,000 tons of rails with the Illinois Steel Company for 1916.

The American Car & Foundry Company is in the market for a number of engine lathes, axle lathes and other equipment for its Detroit plant.

The Chicago, St. Paul, Minneapolis & Omaha has ordered four Pacific and six Mikado type locomotives from the American Locomotive Company.

The Atlantic Coast Line has ordered 2 coaches, 3 baggage and mail, one passenger and baggage car and one private car from the Pullman Company.

The Bangor & Aroostook has ordered 100 80,000-pound capacity steel underframe flat cars from the Standard Steel Car Company for delivery in November or December.

The Seaboard Air Line has placed an order for between 75 and 100 machine tools. Most of these will be installed in the new shops which the road will erect at Portsmouth, Va., to replace those burned several months ago.

The American Locomotive Company has received orders for 15 prairie type locomotives from the Serbian government. The weight of these engines will be 143,000 pounds; cylinders, 19 by 24 inches, and drivers 53 inches in diameter.

The American Railroad Company of Porto Rico has ordered 3 locomotives from the American Locomotive Company. The weight of these engines will be 83,000 pounds; cylinders, 14 and 20 by 20 inches; diameter of driving wheels, 37 inches.

The Alberta Great Waterways Railway and the Edmonton Dunvegan & British Columbia have ordered 100 box cars from the Canadian Car & Foundry Company. The National Steel Car Company is building 10 stock cars for the latter road.

The Madrid, Saragossa & Alicante Railway of Spain has ordered 25 12-wheel locomotives from the American Locomotive Company. These locomotives will have 63-inch driving wheels, 25.2-inch by 25.6-inch cylinders and a total weight of 193,000 pounds.

The Erie has ordered 5 Santa Fe type locomotives from the American Locomotive Company, and has placed additional orders for 28 locomotives of the same type. The total order for 33 locomotives has been divided as follows: American Locomotive Company, 18; Balwin Locomotive Works, 10, and Lima Locomotive Corporation, 5.

The Chicago, St. Paul, Milwaukee & Omaha has ordered 4 Pacific type and 6 Mikado type locomotives from the American Locomotive Company. The Pacific type of locomotives will have 25 by 28-inch cylinders, 75-inch driving wheels and a total weight in working order of 260,000 pounds. The Mikado type locomotives will have 27 by 32-inch cylinders, 61-inch driving wheels and a total weight in working order of 302,000 pounds.

The Chicago & North Western has ordered 12 Pacific type, 10 switching and one narrow gauge locomotives for the American Locomotive Company. Six of the Pacific type locomotives will have 25 by 28-inch cylinders, 75-inch driving wheels and a total weight in working order of 260,000 pounds and 6 will have 22 by 26-inch cylinders, 69-inch driving wheels and a total weight in working order of 302,000 pounds. The 12 Mikado type locomotives will have 27 by 32-inch cylinders, 61-inch driving wheels and a total weight in working order of 165,000 pounds. The 10 six-wheel switching locomotives will have 21 by 28-inch cylinders, 51-inch driving wheels and a total weight in working order of 165,000 pounds. The narrow gauge Mogul type locomotive will have 12 by 18-inch cylinders, 43-inch driving wheels and a total weight in working order of 55,000 pounds.

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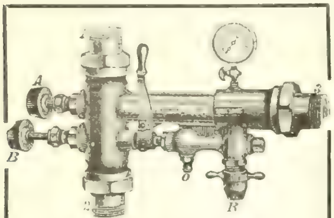
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Books, Bulletins, Catalogues, Etc.

Practical Track Work.

A book of this kind is always of real value when it comes from the hands of a practical man gifted with the faculty of clear expression who does not reach into the infinitude for words that are beyond common understanding. Cicero says that we are all eloquent in the things that we know. Mr. Kenneth L. Van Anker, formerly an extra gang foreman on track work knows his subject thoroughly, and the 216 pages are luminous with intelligence. The book is published by the Railway Educational Press, 14 East Jackson Boulevard, Chicago, and sold at $1.50. Any railroad man who is connected with track work, and procures a copy of this book will get more information from its pages than he can get from any other source, and this is saying a good deal. It is a record of personal experiences, and while it is not intended to be a work on track maintenance, it is masterly in the elemental department of track construction. The diagrams and illustrations are excellent. The details are clarified and the operations are classified so that the earnest reader has not far to seek for what he wants. The book is sure of popular favor because it deserves it.

The Callender Steam Tables.

[illegible] South Kensington, London, prepared tables by experimental measurements, covering the specific heat of water and the mechanical equivalent, the specific heat of steam by the author's continuous electric method,—the adiabatic index with a compensated platinum thermometer,—also the Joule-Thomson cooling-effect with a differential throttling calorimeter. The theory and results of these experiments were published in the Proceedings of the Royal Society and latterly in the Encyclopedia Britannica. The properties of steam were represented by the simplest equations which could be chosen to satisfy the laws of thermodynamics, and at the same time to agree with experiment over the range required in practice. The work constitutes the only complete and consistent system hitherto proposed for steam, and as such is invaluable to those who are interested in the exactitude of the relative valves of the thermodynamical relations in solving problems relating to the discharge of steam, especially in cases where the result depends on small differences. Copies of the work may be had from Longmans, Green & Co., publishers, New York. Price 80 cents.

Baldwin Records.

[illegible] letter press, and illustrations. The former contains complete details in regard to the Triple articulated compound locomotive recently built for the Erie railroad company, a 2-10-2 type locomotive for the same road, and also a Mikado type locomotive, also for the Erie. These locomotives are of more than usual interest from the fact that they all have some special new features, and excellent reports are being heard of their services. Record No. 82, presents details in regard to locomotives for Cuba, Russia, Japan, Yucatan, France, China, Morocco, India, Australia, Chile, Colombia, New Zealand, Korea, Egypt, Brazil, Jamaica, Peru, and Portuguese East Africa. They embrace almost every type of locomotive and every variety of gauge from the 23⅝ inches gauge of the Pechot locomotive for the French government to the common standard gauge.

Accident Bulletin.

Four times a year the record of disasters surpassing that of the *Titanic* or *Lusitania* comes to us from the official hands of the Interstate Commerce Commission. The first three months of the present year shows a grand total of 1,650 persons killed and 35,428 injured. This, however, is nearly one-third less than the fatalities of a year ago, so that, instead of 10,000 fatal accidents on American railroads in one year, as we have sometimes recorded, it looks as if it may not surpass more than one half that number this year. There is hope in this, and an assurance that "Safety First" has some vital significance. As usual, nearly two-thirds of the appalling number of casualties is among those classified as "trespassers, nontrespassers, and employees not on duty." The number of passengers killed for all causes is reduced to 42, as compared with 52 a year ago.

Talbot Boilers.

The Talbot Boiler Company, 120 Liberty street, New York, has issued a descriptive illustrated catalogue setting forth the merits of the Talbot Contraflow Boilers and Uniflow Steam engines. The remarkable records made by the company's products, especially in marine engineering, has attracted wide attention among the engineering fraternity. Their steam power plants are generally conceded to be as different from the ordinary steam power plant as an automobile is from a traction engine. It possesses all of the good features of the gas motor combined with the good features and acknowledged reliability of the steam power plant, and in addition to these has produced new records of thermal efficiency heretofore impossible with any type of power producing equipment. The records on point

[illegible] are so startling [illegible] interested [illegible] new catalogue [illegible] the company [illegible]

The Use and Abuse of Ball and Roller Bearings.

[illegible] is the title [illegible] twenty page treatise by F. J. Jarosch, Chief Engineer of the Bearings Company of America. The text gives explanations and experiences which help in the selection, mounting and lubrication of ball and roller bearings in automobile gears and in all other rotating parts and is intended to help in detecting the real cause of trouble. Nineteen drawings are used to illustrate the text matter. Mr. Jarosch contributes in a very practicable way, valuable thoughts to a much discussed subject, and automobile engineers as well as many others who are interested in the subject will be glad to know that a copy of this treatise may be obtained free upon request from the publishers, the Joseph Dixon Crucible Company, Jersey City, N. J.

Franklin Institute 1915 Year Book.

This welcome year book has been received and very carefully studied. It contains a mass of interesting and valuable information concerning the work done by the Franklin Institute, information that is calculated to increase the reader's admiration of the value to science, art and literature of the great Institute founded by Benjamin Franklin.

The Institute's activities form a most readable chapter, giving facts about the library, the work of the Committee on Science and Art, the journal, The Franklin Institute Journal, the School of Mechanic Arts, lectures, meetings and exhibitions.

Some instances of the Institute's work form a long record of what has been done since 1824. There are numerous other subjects that must be read to be appreciated. Application for copies of this publication should be made to Secretary Owens, Franklin Institute, Philadelphia, Pa.

B. R. & P. Railway Employees' Magazine.

Through the courtesy of President W. [illegible] the *Employees Magazine* published by the Buffalo, Rochester & Pittsburgh Railway. This number is dedicated to the engineering departments of railroads and is a highly creditable production. An autograph extract from an address by [illegible] azine reads

"A patriotic American is a man who is not niggardly and selfish in the things that he enjoys, that make for human liberty and the rights of man. He wants to share them with the whole world, and he is never so proud of the great flag under which he lives as when it comes to mean to other people as well as himself a symbol of hope and liberty."

The magazine contains an interesting foreword outlining the work done in the construction and operation of the Buffalo Rochester & Pittsburgh Railway, then adds "Upon the foundations they have laid and are laying rests the entire superstructure of the organization. The excellence of their work has made possible the wonderful advance in all departments. To every employer the knowledge that he has a property which, from a standpoint of cleanliness and efficiency stands second to none, in a land famed for the excellence of its railroads brings a feeling of pardonable pride and satisfaction."

We heartily endorse that mild boast.

The body of the magazine is filled up with remarkably interesting articles that make interesting and instructive reading for practical railroad men. We congratulate editor James on the numerous attractions of his magazine.

Testing Candle-Power of Arc Lamp.

Erect a rod in the center of a whitened board. Place this some distance from the arc light, so that the rod throws a shadow on the board. Light a candle and approach the candle to the rod, until the two shadows seem of the same intensity. Measure the distance between the arc lamp and the rod, and the candle and the rod, then square the numbers representing these distances; the resulting squares will be the relation between the power of the two lights. If the candle is 3 feet from the rod, and the arc light 60 feet from the rod, then squaring will give 9 and 3,600, so that their relative powers are as 1 to 400.

Felt First Class.

An old Irish countrywoman, going to Dublin by train, stepped into a first-class carriage with her basket, and made herself comfortable. Just before the train started the conductor passed along, and, noticing the woman and the basket, said gruffly, "Are you first-class, my good woman?" "Begorra I am, and thank you," she replied with a smile, "and how [illegible]"

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By ANGUS SINCLAIR

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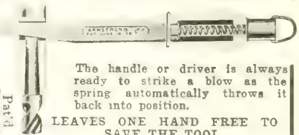

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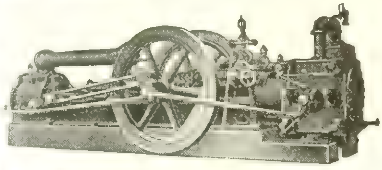

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Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVIII. 114 Liberty Street, New York, November, 1915. No. 11

Substantial and Rapid Progress on the Electrification of the Chicago, Milwaukee & St. Paul Railway

It is interesting to learn that the construction work on the electrification of the western lines of the Chicago, Milwaukee & St. Paul Railway has been prosecuted most [illegible] the initial

[illegible]

order for equipment was placed with the General Electric Company in September, of 1914. In view [illegible] of this project, the progress made to date has been remarkable.

The locomotives, [illegible] forty-two in course of construction, each weighing 282 tons, are being rapidly completed at the Erie works of the General Electric [illegible] plant of the American Locomotive Company. The first complete locomotive was [illegible] tember and shipment was made as scheduled, on September 25. This locomotive [illegible] company at Chicago and is now being exhibited at various points on the Chicago, Milwaukee & St. Paul system under the [illegible] to the president. A complete set of tests indicate that the locomotive will easily exceed the expectations of the designers.

The actual weights of the completed [illegible]

Total [illegible]	564,000 lbs.
Weight on Drivers	448,000 "
Weight per Driving Axle	56,000 "
Weight per Guiding Axle....	29,000 "

Twelve of the locomotives on order are geared for passenger service and the remaining thirty are geared for freight service. Both freight and passenger types are equipped for regenerative braking, this apparatus being under control of the engineer. All of the passenger locomotives and several of the freight locomotives will be equipped with oil [illegible] water.

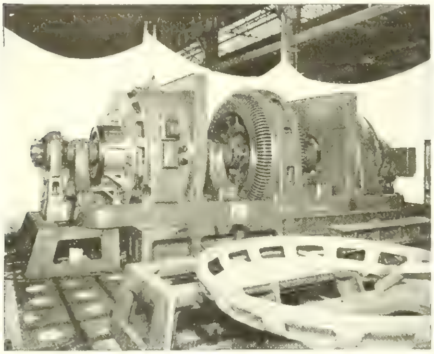
[illegible] include 650 miles of single track, [illegible]

than 200 miles. The 100,000-volt transmission line being erected by the railway company to parallel the electrified tracks has been completed for an equal distance, and tie-in lines from the 100,000-volt system of the Montana Power Company are ready for service. The trackage now ready for train operation includes extensive yards and sidings at Three Forks, Deer Lodge and Piedmont, and passing tracks at other points. The rail bonding crews have followed the overhead construction gangs, completing the ground [illegible]

Illustrations show the general appearance of the new type of trolley construction and transmission lines. It will be noted that wood-pole construction is used throughout, both for [illegible] and bracket construction. The [illegible]

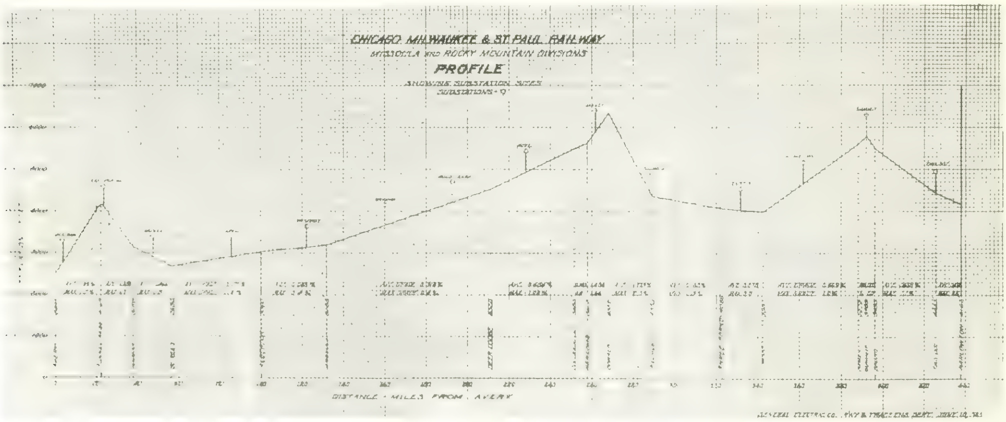
trolley wires are suspended individually and separately from the same steel catenary and the hangers of one trolley wire are located at points mid-span on the other. In the switching yards only one trolley wire is used.

Seven substations, designed to supply power to the first half of the 440 miles of route have been completed and electrical equipment is being rapidly installed. Complete shipments of transformers, motor-generator sets, switchboards and other accessories, have been made by the General Electric Company, Schenectady, N. Y., U. S. A., for the stations first erected, and the equipment of four substations is practically ready for operation. Construction crews are proceeding with the erection of the remaining seven substations shown on the profile between



[illegible] KILOWATT, [illegible] VOLT D. C. MOTOR-GENERATOR SET, C. M. & ST. P. RAILWAY.

SINGLE TRACK CURVE SHOWING OVERHEAD LINE CONSTRUCTION CREWS BONDING THE RUNNING RAILS, C. M. & ST. P. RAILWAY.



[illegible] C. M. & ST. P. RAILWAY, SHOWING [illegible] VOLT DIRECT CURRENT [illegible]

Deer Lodge, Montana, and Avery, Idaho.

Each of the motor-generator sets consists of a 60-cycle, 3-phase, 2,300-volt synchronous motor direct connected to two 1,500-volt direct current generators. The generators are connected permanently in series to supply 3,000 volts to the trolley. Each set is also provided with an exciter at each end, one providing excitation for the revolving field of the motor, and the other supplying the separately excited fields of the d-c. machines.

These sets are in general similar to the five 1,000-kw., 2,400-volt units in operation on the Butte, Anaconda & Pacific Railway except as regards voltage and capacity. One new feature, however, has been added which deserves mention. This consists of a longitudinal ventilation of the core and field coils similar to that employed in the well-known GE ventilated railway motor. The use of this method of cooling has effected a considerable reduction in the floor space required per kilowatt.

The d-c. generators are equipped with commutating poles and compensated pole face windings to insure sparkless cummutation under heavy overloads. This overload capacity is 150 per cent. normal load for 2 hours, and 300 per cent. normal load for periods of five minutes. This will provide ample margin for starting a train of maximum tonnage on the most difficult grades.

The transformers, which are under construction at the Pittsfield works of the General Electric Company, are an example of the most recent design and construction. There are a total of thirty-two of these units, which are to be used for stepping down the power supply from 100,000-volt transmission line to 2,300 volts as required for the synchronous motor-generator sets. These transformers will be installed in fourteen substations, which will furnish power for the entire electrification from Harlowton, Montana, to Avery, Idaho.

These transformers are all of the 3-phase core type with a ratio of voltages of 102,000 to 2,300. For regulating purposes, taps are provided for 97,200 volts and 94,200 volts. Taps are also brought out on the secondary windings to give 1,150 volts, or half voltage for starting the motor-generator sets.

The transformers are oil cooled and the tanks are of the tubular type, the main body consisting of steel plate with tubes welded to the side of the tank at the top and bottom, giving absolutely oil-tight joints. An air dryer and breather is attached to the tank so that all interchange of air between the interior of the tank and the outside must take place through this channel. This dryer is provided with chambers containing a moisture extracting medium, thereby preventing the entrance of moisture to the tank.

In addition to the main transformer equipment, each substation will be furnished with a standard 10-kw., 3-phase transformer stepping down from 2,300 to 110 volts for lighting and auxiliary power circuits.

For operating the railway signal circuits, a standard 25-kw., single-phase transformer is being installed in each substation stepping up from 2,300 to 4,400 volts. A portable oil drying outfit will be used for removing moisture from the transformer oil. This outfit consists of a motor-driven pump which forces the oil through an especially designed filter

ONE OF THE 430 H. P., 3,000-VOLT MOTORS USED ON THE C. M. & ST. P. RAILWAY LOCOMOTIVES.

and the electric drying oven for drying the filter paper. A portable transformer dryer and an oil testing set will also be supplied.

Prussian Railways.

A recent report in the first number of a publication, *Der Staatsbedarf*, just issued, announces that the Prussian-Hessian Government Railway and the Imperial Railroad of Alsace-Lorraine have placed orders for 763 locomotives, 35 passenger coaches, 14 baggage cars, and 13,200 freight cars, all to be built in Germany.

The Belgian Railways.

The Belgian lines have now been completely taken over by the German war office, and only Germans are employed, even the old porters not being allowed at the stations. To obtain a ticket it is necessary to have a special pass from the military police headquarters and before obtaining this permit the applicant has to state not only where he is going, but for what reason and for how long. All these facts are duly noted down on the pass. Only German coinage is accepted in payment for a ticket, Belgian money being refused. Civilian passengers are only permitted to travel in third-class cars, for which, however, they pay first-class fares. Second-class cars and the so-called first-class cars (some of these are only known as "reserved," the first-class proper having vanished in Belgium a few years ago to save on international trains) are labelled to show that they are exclusively reserved for military passengers. Before the traveler reaches the station he is searched by soldiers and the train itself is reached by walking a quarter of a mile or so from the station.

New Railway in Bolivia.

The line from Uyuni, Bolivia, a station on the Antofagasta & Bolivia Railroad, which has been under construction in a southeasterly direction towards Tupiza, is to be extended, it is said, to the present northern terminus of the Argentine railway at La Quiaca, a point on the frontier directly south of Tupiza. The completion of the line from Uyuni to Tupiza and the construction of a line between Tupiza and La Quiaca will provide a new through railroute from the Atlantic ocean to the Pacific.

Railways in Finland.

At the beginning of 1914 the total mileage of the Finnish State Railways, including 207 miles of line owned by private capital, but operated by the State lines, was 2,537. Finland has 2,765 miles of navigable waterways, of which, with the present facilities, it is estimated that the freight capacity is about 1,600,000 tons a year. The waterways as well as the railways are under the administration of the State.

New Haven's Efficiency Tests.

During the first half of 1915, the New York, New Haven and Hartford Railroad Company made a total of 12,899 signal tests, with a percentage of 99.75 perfect. No passenger was killed in train accidents on the railroad during that period. These signal tests indicate a high record of efficiency on the part of the employees of the New Haven Company, and such efficiency is always accompanied by a decrease in train accidents. The signal tests are made by the Operating Department under every conceivable condition, and the record for the first six months of 1915 of 99.75 per cent. perfect shows how thoroughly the employees of the company are living up to the strict letter of the rules.

The Lackawanna people are experimenting with an invention attached to the engine tender for indicating the weight of coal that has been used. It has been applied only to one tender, but the inventor is to make its use general should it prove satisfactory. The device con- [illegible] machine in the coal box floor, the record of the weight showing on dials. The real advantage of its application being in showing the exact weight of coal at all times in the coal box. At the end of a trip this would be of special value.

Locomotive Running Repairs

By JAMES KENNEDY

III—Readjusting the Walschaerts Valve Gear

As was shown in the previous chapter in the case of adjusting the valve setting of a locomotive equipped with the Stephenson shifting link, it is possible under almost any condition to arrange the eccentrics and eccentric rods to bring about an exact opening of the valve at the desired point of the piston stroke on either the forward or backward motion of the engine. On an engine equipped with the Walschaerts valve gear this is not always the case if there exist any organic defects of a serious kind in the original construction and in the exact dimensions of the parts, and even with the most careful construction of the parts it will frequently be found when they are assembled that there are some slight variations in the valve openings which, although they may not be past finding out have to be dealt with by such means as experience has shown by repeated experiment to be the surest and quickest. Among the earlier locomotives equipped with this valve gear there was not that degree of nicety in setting the eccentric crank which now obtains. Neither was the correct length of the main rod always maintained with that degree of exactitude which is very essential to the proper position of the valve. The location of the eccentric crank at right angles to the main crank, and the maintenance of the main rod at the length specified by the constructing engineers are prime requisites, and any [illegible] the exact position of [illegible] the length of the latter leads to a wilderness of problems that are difficult, if not impossible, of solution.

[illegible] the parts, slight variations will manifest [illegible] and [illegible] crease in error in mechanism as well as in all other things, the variations from the exact point desired will gen- [illegible] comotive has been in service a short time. This is to be expected, as the bearings naturally adjust themselves to the line of least resistance, the high tension and constant reversions of pres- [illegible] show their inevitable result at the ex- [illegible] valve opening at either front or back [illegible]

piston variety are adjustable by the use of liners in the valve stem. This, of course, necessitates the removal of the valve to insert or withdraw the liners required to equalize the position of the valve.

After this has been accomplished, assuming that there is a variation between the amount of valve opening on the forward and backward motions and supposing that the engine is on the forward dead center on the left side and the amount of lead or opening of the

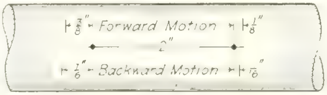


FIG. 1

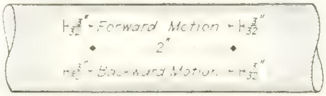


FIG. 2

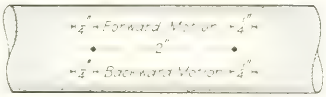


FIG. 3

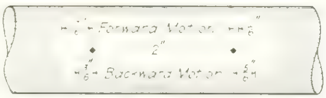


FIG. 4

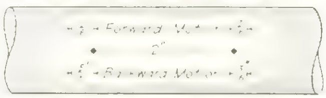


FIG. 5

valve should be increased, the valve must necessarily be drawn back toward the link. If the engine is in the forward motion with the link block in the bottom of the link this will necessitate a shortening of the eccentric rod, and on removing the pin connecting the forward end of the eccentric rod from the [illegible] position, and moving the valve the required distance, it will be seen by the variation in the edges of the hole in the link arm from that of the eccentric rod how much the eccentric rod would re- [illegible]

This method, however, is not entirely to be depended upon, as there is always some lost motion both in the valve and radius rod connection, as well as in the central pivot upon which the link is suspended. These, in addition to the link block, would admit of a slight movement backward or forward of the extreme point of the link arm without showing any motion of the valve. Generally speaking, the eccentric rod would require to be shortened at least twice as much as the amount required in the opening of the valve. The exact ratio can be determined by measuring the distance from the central stud upon which the link oscillates to the center of the link block, and supposing this distance to be nine inches, then measuring the distance from the central stud to the center of the link arm connection with the eccentric rod, and supposing that to be eighteen inches, it will thus be seen that the eccentric rod must be shortened twice the amount that we desire to move the valve or increase the opening the required amount.

While these may properly be ranked among the simpler problems arising in the necessities of rectifying the Walschaerts valve gear, it more frequently happens that the variations arising both in the original adjustment and the subsequent discoveries are of a more intricate kind, and for the better and fuller elucidation of valve conditions in actual practice some diagrams are appended that have been taken by experienced mechanics in leading locomotive shops: The dots on the diagrams represent prick punch marks on the left side valve stem marked by a suitable valve tram from some convenient point and showing the exact point of valve opening with outside admission. The adjacent lines show the irregularities in the lead when the engine is on the dead centers. Giving our attention to Fig. 1, it will be noticed that in order to nearly square the lead, the valve must be moved 1/8 in. ahead in the forward motion, and on the back motion it must be moved 3/16 in. ahead. As the errors in the two motions occur in the same direction, it follows that the greater one partially neutralizes the effect of the lesser, and that the combined average error will be the difference between the two, that is: 3/16 in. minus 1/8 in. equal 1/16 average error. In order to divide this average error of 1/16 in. equally about a central point, it will be necessary to move the valve one-half this amount, or 1/32 in., in this case 1/32

in. back in the forward motion. The eccentric rod must be shortened 1/16 in., in the proportion of two to one, to move the valve this distance. The markings on the stem will then show as in Fig. 2.

The forward and backward motions having thus been equalized, it only remains to square the lead for the front and back for both openings. This can be accomplished by lengthening the radius rod 5/32 in., the difference between the two openings, and the valve openings will be equalized as shown in Fig. 3.

It should be constantly borne in mind that other details of the gear should be observed, as, for instance, the exact length of the reach rod, which should be such as to bring the link block at equal distances from the central point of suspension when the reverse lever is in either the extreme front or back notches. Any marked variation from this equalizing of the link block with its attached radius rod necessarily affects the location of the valve, and the aptitude to look for remedies in the wrong direction would only lead to further error.

Referring further to valve markings that may show a more complex variety of markings than in the foregoing, assuming that the tram markings may show as in Fig. 4, it will be observed that the errors occur in opposite directions, and consequently any change in the valve liners would merely augment the error. The combined, or average, error equals ¼ in., and to divide this error equally about a central point it will be necessary to move the valve one-half the amount, or, in this case, ⅛ in. ahead in the forward motion. This will necessitate a lengthening of the eccentric rod ¼ in., in order to move the valve ⅛ in. The markings will then show as in Fig. 5. In order to square the openings as before it simply remains to move the valve ahead 1/16 in., and this may be done as already described in the previous experiment by lengthening the radius rod 1/16 in.

From the foregoing it will be observed that the errors in forward and backward motion are equalized by changing the length of the eccentric rod; and the lead can then be squared by changing the length of the radius rod the necessary amount as has been already described.

It may be added, in conclusion, that while these changes may occasion departures from the exact dimensions presented in the blue prints usually furnished by the constructors, they do not materially affect the organic structure or action of the valves, but merely tend to aid in rectifying the variations in the mechanism where circular motion is changed into linear motion, and at best are merely hints in the direction of attaining that degree of exactitude essential in the economic use of steam. Experience, at best, is slow in the complete mastery of any art, and it will be found that even guided by the experience of others, all approaches to perfection are always difficult of accomplishment.

Fewer Hours and How to Obtain Them

By C. RICHARDSON, New Haven, Conn.

State Legislatures and Labor Unions Have Done Much

Mutual Concessions the Only Sure Path to Success

It is noteworthy to observe that the able article published in RAILWAY AND LOCOMOTIVE ENGINEERING in the September issue has been extensively copied in the engineering press and favorable comments made on the clear logic and strength of the arguments used. The conclusions, however, were not altogether to my mind. Both the legislatures and the unions have done much to obtain fewer hours of labor in many mechanical occupations, and many are convinced that if a little more common sense both on the side of labor as well as capital were used a larger progress would be made. It will be generally admitted that strikes have seldom mended matters. The sudden stoppage of work in any department of human activity, especially on contract work, is a severe blow to employers, whose contracts are almost always obtained at the lowest possible prices based on the existing conditions obtaining at the time that the contract is secured, and any shortening of the hours of labor and consequent increase of costs is a gross injustice to the contractors. Not only so but a prolonged strike is ruinous to the worker, and even if successful it takes much time to make up for the loss incurred, not speaking of the bitter feeling naturally arising from the success or defeat of the contending parties.

To my mind the only reasonable way out of the difficulty would be that when a demand is made looking toward reducing the number of hours of labor a reasonable notice should be given to the employers allowing a certain number of months to elapse before such requests could be expected to be granted. Even on the railroads it would only be common justice that some such period should be granted in order that a readjustment of conditions might be arranged to meet the situation.

Doubtless this has been suggested before and met with the argument that the employers thus notified would meet the situation with fresh forces taking the place of the proposed strikers, but I have seldom heard of an instance where some advance was not made when the employers were properly approached in this spirit. Organized labor is apt to take advantage of sudden busy spells in certain industries and precipitate strikes that might be avoided if milder measures were used. Many instances could be given to prove my contention, and not only so but it is universally found that the closer the relation between employers and employees the more likely will the spirit of good will be manifested when emergencies arise.

As an illustration, in the depression of railroad traffic in New England during the year, a large number of skilled mechanics have been granted leaves of absence in order that they may secure better, although perhaps only temporary, employment in the machine works and shops that have recently become very busy. These men are generally granted a leave of absence of thirty days, and, on returning to report, the time is extended if desired, the employee retaining his standing in regard to kind and period of service, with such benefits and old age pension as may be the rule in regard to a long period of continuous service.

In conclusion it will be observed that these remarks are not intended as a contradiction of the views set forth in your pages, but rather as supplementary, and it might not be amiss to go a step further and express the belief that better times are coming soon for the railroads, and while it is common for a certain prejudiced class of politicians and others to lay the blame of the depressed business conditions on the European war, the fact is well known to every intelligent person that the poor times were here before the war began, and New England is a particular proof of the truth of the saying of a shrewd Irish woman who was informed by a garrulous neighbor that this was an awful war, admitted the fact, but naively added that "it was better than no war at all!"

Definition of Braking Power

By WALTER V. TURNER, Assistant Manager Westinghouse Air Brake Co.

"Per Cent. of Braking Power," and Other Air Brake Expressions Almost Meaningless. "Braking Ratio" Preferable

[illegible] this subject of [illegible] gear for passenger [illegible] it might be well to first [illegible] exactly what is meant by some of the terms and expressions used in reference to foundation brake gear problems. "Braking power" and "Per cent. of braking power," are terms almost universally used and "per cent of braking power" is taken to mean that some certain force results through a multiplication of cylinder value through a leverage system, but this term, taken by itself, is vague, indefinite and ambiguous, [illegible] otherwise explained, this may mean the ratio of the shoe pressure to the weight of the car and this either for service or emergency or both, or it may be intended to mean the ratio of the retarding force to the [illegible] this term may be for either service or emergency or both, or it may be taken to mean the ratio of brake shoe pressure to the weight of the [illegible] losses in t [illegible]

The term "braking power," strictly speaking, applies only to the shoe pressure or total cylinder pressure times the leverage ratio, which does not necessarily have any fixed relation to the weight of the car, while "per cent. braking power" [illegible] cannot be used synonymously for the correct expression of any intended meaning.

[illegible] air [illegible] basis and is not a convertible term, and, except the user consciously or unconsciously translates the expression, it has no practical value. In the writer's judgment, it is not a sufficient justification for its use to say that its various usages are understood by air brake engineers, for we [illegible] power inherent in a brake, but the layman to whom, if we are to convince and per- [illegible] naturally understands, from the fact that they are not arbitrary. As the term in [illegible] a factor in the case we are now considering, and since even when applied to the [illegible] installation, the expression "braking ratio" [illegible] braking power" and retarding force have [illegible] speaking of dissipating the energy stored in a moving train, and since the actual ratio of brake shoe pressure to the weight of the car gives but little information as to the actual length of the stop, it would seem that a term to indicate the retarding force should be employed, and this to mean the stopping force actually realized and not to refer to the shoe pressure of the installation, in fact such a term is now used in brake test analysis, for the factor of retardation is the ratio between the average actual stopping force realized and the weight of the car.

Some time ago in speaking before a railroad association, I had occasion to point out the confusion arising from assuming braking ratio and factor of retardation to mean the same thing, therefore it is desirable that these terms should be clearly defined, and when understood it will be observed that the former is better adapted for use when brake installations are being considered, and the latter as a criterion of brake performance. This becomes apparent when it is remembered that uniformity of stopping distances cannot be assured for any car, even though all of the equipment is of the generally accepted proportions, by arbitrarily prescribing any braking ratio, unless three other factors can be known and assured, these are, time in which to obtain the required brake cylinder pressure, the efficiency of the brake rigging and the coefficient of friction of the brake shoe. If these three things are known, the percentage of braking ratio or so-called "braking power" necessary to produce a given stop from a given speed can be calculated, but in general practice these factors are not known when contemplating a brake installation, therefore nothing but an arbitrary percentage can be determined upon.

Now we are told that a passenger car is braked at 90 per cent. of its light weight, or at 90 per cent. braking power for a full service application, or at 90 per cent. based on a 60-lb. cylinder pressure, all of which is decidedly indefinite, as full service application, to many means the equalizing point of the auxiliary reservoir and the brake cylinder, which in present day practice is quite variable, being 50 lbs. if 70 lbs. brake pipe pressure is carried, 60 lbs. if the pressure in the brake pipe is 90 lbs., also 60 lbs. if 110 lbs. is carried, and a reducing valve used in the brake cylinder, and again 86 lbs. if the P. C. equipment is used, therefore if this expression means 50 lbs. brake cylinder pressure to one man, 60 to another and 86 to another, the expression should be abolished, for if car brake leverages designed from this point of view were placed in service, and braked at the 90 per cent. on the given cylinder pressure, and the pressure carried in the brake pipe was 90 lbs., the first car mentioned as having a braking power based on a 50-lb. cylinder pressure would actually have a braking ratio of 110 per cent., the second, based on 60 lbs., it would be 90 per cent., and on the P. C. equipment car it would be 70 per cent.

The expression, 90 per cent. braking power, based on a 60-lb. cylinder pressure or a certain other brake cylinder pressure, is also a vague and ill chosen expression, for it gives more information than is required when one is concerned only with the question of what ratio shoe pressure should bear to the weight of the car, and far less than what it should give when one is concerned with an actual brake installation, no matter whether this brake installation is being made to produce a specified rate of retardation, or is merely to equip a car with a brake.

From this it will be evident that the term "full service braking power" has no more precise meaning than the expression "based on a 60-lb. cylinder pressure."

Now if we understand the term braking ratio to refer to the calculated braking effect during installation, and factor of retardation to indicate the actual average stopping force realized in brake performance, a more correct expression would be, a 90 per cent. braking ratio, obtained in 7 seconds' time, and based on a 24-lb reduction in the auxiliary reservoir. We are here referring chiefly to correctness in expression, but if the base here given is followed, uniformity in braking ratio will be obtained and smoothness of operation will, to a certain extent, be insured, at least so far as installation is concerned, but it is not intended to state that 90 per cent. is the best possible ratio, but there are many more reasons for its retention than there are for an endeavor to change it.

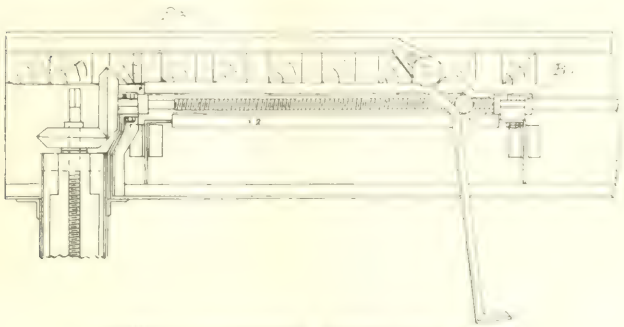
It will thus be seen that there is need of improvement in the terms used in speaking of the air brake, but it is sometimes easier to make improvements in mechanism than it is to rectify errors in speech which are conceived in ignorance, and crystallized by habit, but as time advances doubtless errors of this kind will be rectified and as the mechanism of the air brake approaches perfection, doubtless so will the nomenclature in regard to it become clearer in expression and distinctly definite in meaning.

Detecting the Cause of Post Spindle Breaking

By J. G. KOPPELL

Electrical Superintendent of Bridges, Stault Ste., Marie, Michigan

A drawbridge that has been in service for nearly thirty years had latterly a peculiar tendency to break a post spindle from time to time. The bridge was at a considerable distance from the main office, and the supervision was entrusted to a local station agent, and all he knew was that when the spindle broke to order a new one from the local machine shop, and forward the bill for payment.



SECTION OF DRAWBRIDGE SHOWING POST SPINDLE

The bills came too often and the management decided on sending an experienced engineer to try and discover the cause of the repeated breakages, and it was soon found upon tracing the various points that the gearing was changed from a comparatively light gear to a heavier gear. By referring to the bearing B1 on the drawing it will be seen that the bearing is proportionately heavy enough, when re-bored to take the heavier shafting. The bearing box, B 2, was rebored too much in the cup, in order not to make the bottom part too light. By reason of the bearing separating plate being much higher at that end than at the other, the effect was that the spindle was one-quarter of an inch out of line.

It was also learned that the spur gears had been changed from time to time without paying due regard as to whether they were the exact mesh or not, consequently shims had to be placed below the bearing box so that the spur teeth would not lock each other, and with this added cause, the spindle was thrown half an inch out of line.

It will therefore be readily understood that the attachment X1, through which the spindle passes, under these conditions of the spindle bearings, between rigid angle-bar guides, managed to carry the spindle as far as X 2 by considerably bending or sagging the spindle, but after repeated operations and consequent bendings the spindle finally broke at that point. Hence the lesson in regard to the inevitable results of cheap, unskilled supervision which is a common weakness on some quarters.

A Lively Old Timer on the Erie. By Andrew Fallon, New York.

The Erie has a number of locomotives whose histories would make interesting reading. Among them is the "Flying Queen," that won a famous race in its earlier and palmy days. It is [illegible] known as No. 101, and is still doing excellent service, although it was old enough to vote many years ago. It was rebuilt by the New York, Susquehanna & Western, and is now equipped with several modern devices. The cylinders are 19 inches by 24 inches. Driving wheels, 68 inches. Mr. George Mann is engineer, a member of the Brotherhood of Locomotive Engineers, No. 521. Mr. Joseph Lawler is fireman, a member of the Brotherhood of Firemen and Enginemen, No. 543. They are ready to give any locomotive in America five years start in point of youthfulness, and five miles start in a hundred miles of a run.

Reminiscences of the First Train Despatched by Telegraph.

Albert H. Copeland, a native of Middlebury, Vermont, died recently at Milwaukee, Wis., in his eighty-fifth year. He should be remembered as the first man who dispatched a train by telegraph. In 1852 railroads had no telegraph service of their own. They ran by time card rules, and waited at certain points until other trains passed. If one train was late the other had to wait. One morning in February, 1852, a north bound train was in a snow bank in the Green Mountains south of Rutland. Mr. Copeland was then local telegraph operator at the post office at Middlebury. The conductor of a south-bound train was, of course, unaware of the stalled train, and all he knew was that he and his train load of passengers had to wait at Middlebury. The rule was that he could proceed after twelve hours. The passengers grew impatient. Mr. Copeland took in the situation and telegraphed to the superintendent at Rutland and received a reply ordering the train to proceed. The conductor at first demurred, but when Copeland offered to ride on the engine, and the passengers insisted, the train proceeded. Mr Copeland's happy thought resulted in [illegible] over the Rutland railroad after that date, and the method was quickly adopted by other railroads and soon came into use all over the world

New Six-Wheeled Type of Switching Locomotives for the Chicago Great Western Railroad, and the Public Belt Railroad Commission of New Orleans

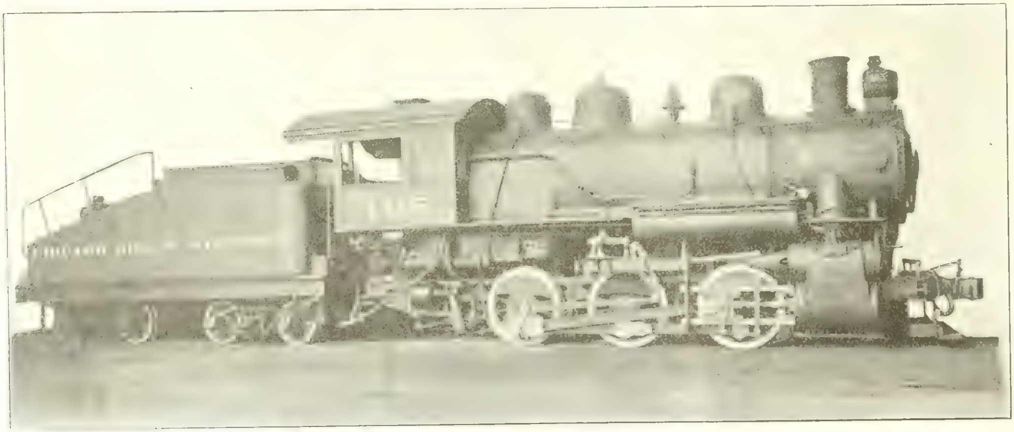
Not the least important part of the locomotive equipment of a railway is the power assigned to switching service. The work to be done is usually of such a nature that the locomotives must be specially designed for it. Weight and clearance limitations must be considered in the preparation of the design, and the service requirements frequently call for the application of special equipment. The largest locomotives now in this class of service equal heavy road engines in hauling capacity, and in some cases, where hump yards are in operation, switchers of the Mallet type, of considerably greater capacity than the road engines used on the division, are employed.

[illegible] not only increased in size and capacity during recent years; their efficiency, also, has been greatly improved. Many of these locomotives are now being equipped with superheaters and brick arches, with a resulting saving in fuel and water consumption, a reduction in smoke and an increased capacity per ton of locomotive weight.

Such devices as power-operated fire-doors, and power reverse gears, are also frequently applied to heavy switching locomotives, making the engine easier to handle and enabling the engine men to do their work more efficiently.

The accompanying illustrations show two six-wheeled switching locomotives which have recently been completed by the Baldwin Locomotive Works. Each engine is one of five, built respectively for the Chicago Great Western Railroad and the Public Belt Railroad Commission of New Orleans. In both cases, superheated steam is used; but the locomotives differ materially in details of design.

The Chicago Great Western locomotive exerts a tractive force of 35,350 pounds. The boiler is of the straight top, wide firebox type, with Gaines combustion chamber and security sectional arch. A pneumatic fire-door opener is applied. The throttle is of the improved Rushton type, with a drifting valve mounted in the top of the main valve. With this arrangement [illegible] relief valves or by-



SIX-WHEELED TYPE OF SWITCHING LOCOMOTIVES FOR THE CHICAGO GREAT WESTERN RAILROAD.

[illegible] Baldwin Locomotive Works, Builders.

pass valves are applied. The steam distribution is controlled by 13-inch piston valves, which are driven by Walschaerts motion. The crank-pins are of chrome vanadium steel.

The locomotives for the Public Belt Railroad of New Orleans are somewhat lighter than the Chicago Great Western engines; they are designed to traverse curves of 43 degrees, and will be largely used in work about warehouses, etc. A long firebox, placed above the engine frames, is used in this design. A brick arch is supported on studs. A drifting throttle, similar to that used in the Chicago Great Western locomotives, is applied; but in the New Orleans engines, vacuum valves are also used. The piston valves are 12 inches in diameter, and they are driven by the Southern valve gear, which is used in combination with the Ragonnet power reversing mechanism. The latter device is a great convenience on a switching locomotive, where frequent reversing is necessary and the locomotive must often be "spotted" accurately. In the present instance the reversing mechanism is placed on the right-hand side of the boiler immediately in front of the tumbling shaft, with which it is connected by a short reach rod.

The driving tires of these locomotives are of hard steel, heat treated in oil. The main wheel centers are of cast steel and the others are of cast iron. The third pair of wheels is the main pair, this arrangement being used in the Chicago Great Wetern locomotives also.

The Public Belt locomotives exert a tractive force of 29,500 pounds, and with a liberal ratio of adhesion they should be able to develop this even with unfavorable rail conditions.

The dimensions of the two locomotives described above are as follows:

Chicago Great Western Railroad.

Gauge—4 ft. 8½ ins.

Cylinders—21 x 26 inches.

Valves—Piston, 13 ins. diameter.

Boiler—Type, straight; diameter, 68 ins.; thickness of sheets, ⅝ ins.; working

pressure, 185 lbs.; fuel, soft coal; staying, radial.

Firebox—Material, steel; length, 102 ins.; width, 6 ins.; depth, front, 63½ ins.; depth, back, 59½ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, ⅜ in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space—Front, 4½ ins.; sides, 4 ins.; back, 4 ins.

Tubes—Material, steel; thickness, No. 9 W. G. and No. 11 W. G.; number, 24, 171; diameter, 5½ ins., 2 ins.; length, 11 ft. 6 ins.

Heating Surface—Firebox, 144 sq. ft.; tubes, 1,416 sq. ft.; firebrick tubes, 19 sq. ft.; total, 1,579 sq. ft.; grate area, 32.5 sq. ft.

Driving Wheels—Diameter, outside, 51 ins.; center, 44 ins.; journals, main, 10½ x 12 ins.; others, 9 ins. x 12 ins.

Wheel Base—Driving, 11 ft. 6 ins.; rigid, 11 ft. 6 ins.; total engine, 11 ft. 6 ins.; total engine and tender, 44 ft. 1¼ ins.

Weight—On driving wheels, 148,200 lbs.; total engine, 148,200 lbs.; total engine and tender, about 265,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 5 ins. x 9 ins.; tank capacity, 6,000 gals.; fuel capacity, 8 tons.

Engine equipped with Schmidt superheater. Superheating surface, 299 sq. ft.

Public Belt Railroad Commission, New Orleans.

Gauge—4 ft. 8½ ins.

Cylinders—19 x 24 inches.

Valves—Piston, 12 ins. diameter.

Boiler—Type, straight; diameter, 64 ins.; thickness of sheets, 11/16 in.; working pressure, 200 lbs.; fuel, soft coal; staying, radial.

Firebox—Material, steel; length, 96 3/16 ins.; width, 41 ins.; depth, front, 66 ins.; depth, back, 63½ ins.; thickness of sheets, sides, ⅜ in.; thickness of sheets, back, 5/16 in.; thickness of sheets, crown, ⅜ in.; thickness of sheets, tube, ½ in.

Water Space—Front, 4 ins.; sides, 3½ ins.; back, 3½ ins.

Tubes—Material, steel; thickness, No. 9 W. G. and No. 12 W. G.; number, 21, 143; diameter, 5½ ins.; 2 ins.; length, 10 ft. 6 ins.

Heating Surface—Firebox, 146 sq. ft.; tubes, 1,095 sq. ft.; total, 1,241 sq. ft.; grate area, 27.4 sq. ft.

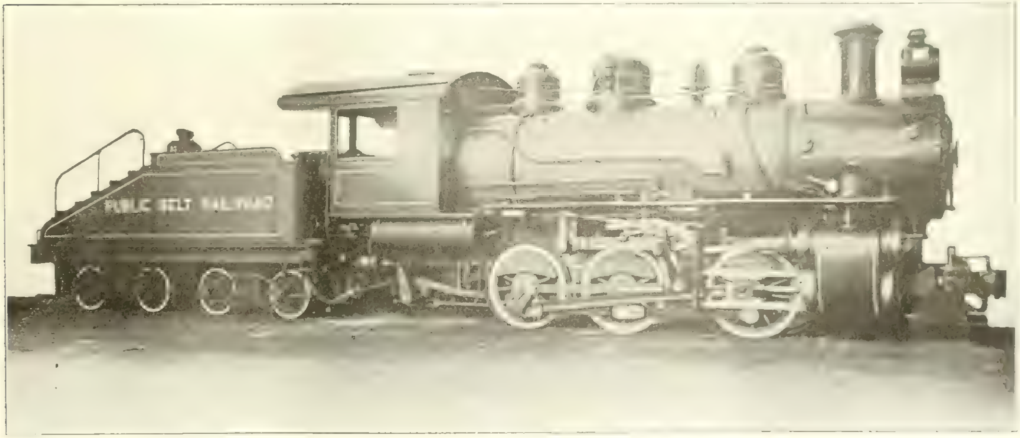
Driving Wheels—Diameter, outside, 50 ins.; center, 44 ins.; journals, main 8½ x 9 ins.; others, 8½ x 9 ins.

Wheel Base—Driving, 11 ft.; rigid, 11 ft.; total engine, 11 ft.; total engine and tender, 41 ft. ½ in.

Weight, Estimated—On driving wheels, 130,000 lbs.; total engine, 130,000 lbs.; total engine and tender, 210,000 lbs.

Tender—Wheels, number, 8; wheels, diameter, 33 ins.; journals, 4¼ x 8 ins.; tank capacity, 4,000 gals.; fuel capacity, 5 tons.

Engine equipped with Schmidt superheater. Superheating surface, 252 sq. ft.



TYPE OF SWITCHING LOCOMOTIVES FOR TH[illegible]

W. [illegible] Hardee, Chief Engineer. [illegible] Works, Builders.

An Inventive Fireman.

In one of John Hill's reminiscent articles he wrote: "Once upon a time I was sent out to the west end to break snow. It was one of those great big wedge plows built onto the front of the engine, and the habit it had of covering up the cab, inside and out, was partly its fault and partly the fault of the cab.

"A young Swede, named Dennis Murphy, was smoke maker on the "Snowbird," as our engine was called, and he was a genius for scheming devices to put on the engine. He read a railroad paper that was full of kinks designed by grocers and plumbers for locomotives, and among other fool things was an item about putting a double glass [illegible] cab and filling the space with alcohol to prevent the frost forming on the window.

"Dennis worked four nights and one Sunday to make a tight joint between the double panes of glass, and filled up the space with alcohol. When the job was finished he offered to make a whiskey door, as he called it, on my side. But we had to go out into the snow drifts and Dennis was very proud of the action of the whiskey window in resisting the drift and prevented ice forming. He was holding up the torch to light his pipe when a lump of ice broke through the window and deluged Dennis' head with alcohol which took fire and was proceeding to burn him up when an avalanche of snow put out the flames.

"Dennis was hugely disgusted with his whiskey window, but the burning did not stop his inventing. Within two weeks he rigged up a pole and monkey arrangement that was to open the fire-box door and start the blower when the throttle was shut off. This was going to save coal and work, mostly work, but it needed considerable adjusting before it worked just right and while making what he thought would be the final adjustment, the pesky thing took off his thumb. That ended Dennis' inventions, but he had a sneaking belief that there was money in that line of endeavor."

Cincinnati Screw Company.

The Cincinnati Screw Company has purchased the plant and equipment of the Cincinnati Screw & Tap Company, consisting of over one hundred automatic screw machines from ¼-in. to 2-in. capacity, and the plant is already in full operation.

Government Railway Management in Canada.

The Canadian government has recently assumed the operation of the National Transcontinental Railway, extending from Moncton, N. B., to Winnipeg, Man., 1,084 miles, because the Grand Trunk Pacific Railway Company, which had been expected to lease and operate the road on its completion, declined to do so. The refusal of the Grand Trunk Pacific was based on the ground that the road was not finished, and that because of the enormous expense which the government had incurred in construction, it could not afford to lease the line and operate it at a rental of 3 per cent. on its cost.

This marks the climax of the failure of the Canadian government as a railway builder. Advocates of government ownership in this country have made much of the argument that governments can borrow money at lower rates than private companies are obliged to pay and thereby reduce the cost of transportation.

The experience with this Canadian railway shows that while the government was able to raise capital more cheaply than a corporation, it spent so much more in building a mile of railway than a private corporation would have, that the total interest charges that must be paid for are far greater than they would have been if the line had been built by a private company.

The entire history of the National Transcontinental Railway is a most instructive and interesting chapter in the annals of government railroad management. The plan for a new transcontinental railway across Canada was made in 1903 by the Liberal government. The Grand Trunk Pacific Railway was to build the line from Winnipeg west to Prince Rupert, which has recently been put in operation, and the government was to build the line from Moncton to Winnipeg. By an agreement of July 29, 1903, the eastern division after its construction according to government specifications was to be leased to the Grand Trunk Pacific, which was to operate and maintain it for 50 years, furnishing the equipment [illegible] seven years of the term.

Great Northern Feat.

[illegible] of the Great Northern Railway for the [illegible] off in gross operating revenues of $9,692,-079. The report, made public last month, showed a net operating revenue of $1,-249,419 greater than the previous year. A reduction of operating expenses by $10,941,499 and an increase in other revenue enabled the railway to make this unexpected good showing. The [illegible] 162,857. The total operating expenses were $36,828,274. The net income was $20,618,270.

"The decrease in gross," says the report of L. W. Hill, president of the Great Northern, "was occasioned by poor crops, by reduction in rates partly resulting from Governmental orders, and by the general business depression, due partially to the war in Europe.

"Last season's grain crop, approximately 115,000,000 bushels, was considerably below the average, owing to damage caused by black rust and hot winds. The 1915 crop along the company's lines is better than ever before, both as to quantity and quality, and is estimated at not less than 178,000,000 bushels. The revenues of the company should be materially increased as the result of this good crop."

Westinghouse Electric Company Establishes Saving Fund for Employes.

In order to encourage the spirit of thrift among its employes the Westinghouse Electric & Mfg. Company has just established a savings fund which offers facilities to the employes for the handling of their savings accounts. This fund is open to any employe of the company wherever he may be located, and he may become a depositor at any time and discontinue at any time. The amount of the deposit cannot be less than 10 c. and may be any multiple thereof and the deposits must be made from each regular pay. The deposit, however, is limited to one account, the amount of which in any one year cannot exceed $500. The idea of this is that the plan is intended as a method of encouraging the employe to save his earnings and when he has been successful up to this point, allow him to handle his own finances. Interest is paid on the deposit at the rate of 4½ per cent. and is credited semi-annually.

Telephone Dispatching on the Baltimore & Ohio.

[illegible] has been adopted on the Ohio division of the Baltimore & Ohio Southwestern railroad on the main [illegible] 1000 miles [illegible] company's lines over which trains are dispatched by telephone, including the lines from Cincinnati to Seymour, Ind., and from Seymour to Louisville. It is also used on a large number of the eastern divisions and the Baltimore and Ohio was the first railroad to recognize the advantage of the telephone as an additional factor of safety in train dispatching, and, following its incorporation in the book of rules governing train handling, investigations were made by railroad officials of Russia, France and other foreign countries.

Results of Senseless Competition.

The president of a modern, up-to-time railroad is likely to understand very clearly the disadvantages that arise from interference with railroad management by outside meddlers. At the Traveling Engineers' convention held in Chicago last month, Mr. C. H. Markham, president of the Illinois Central Railroad, made an address, and his principal theme was the unfair attacks on railroads and excess of regulation. It is easily within our memory, when the majority of sound business men were apprehensive that the great trunk railroads under the control of their respective magnates would enter into a mighty combination, which control legislatures and obtain permission to the exaction of extortionate rates for passengers and freight.

Those who dreaded that consummation did not take into account the weakness of human nature in meeting or taking part in the competition for business. When the dread of the business tyranny that would result from combined monopoly was rampant, the U. S. Interstate Commerce Commission was established to restrain the dreaded rapacity of railroad magnates, but its restraining power was not needed. Competition had done its perfect work, and the principal need of the Interstate Commerce Commision was to restrain ruinous rate cutting. That commission has granted some increases of freight rates, but they are, as a rule, still too low, thanks to the senseless actions of the competing companies years ago.

Consumption of Track Ties.

Members who were familiar with the forests in the United States twenty years ago frequently express wonder at the way woodlands are decreasing in density. The growth of industries and the demand for new dwellings put a tax on forest growth much greater than the raw supply provided by nature, but the great devastator of forests is the demand made for railway appliances, such as cars and track ties. The latter necessity puts a great strain upon the timber producing resources of every country where long railway mileage exists.

From the latest statistics of railway details that we are acquainted with the railways of the United States use up over 20,000,000 track ties every year. Some efforts have been made to use steel instead of wood for ties, but the metallic tie makes very slow progress into favor. As a tree of ordinary dimensions will only yield about eight track ties, the rapid progress of deforestation is easily understood. As the natural growth cannot begin to keep pace with the felling of the trees, the period that will pass when metal ties must be forced into use is not far distant.

New United States Bureau of Standards' Test Car, Built by the Pennsylvania Railroad Company

A special car, which will be known as the United States Bureau of Standards' Test Weight Car No. 2, has just been completed by the Pennsylvania Railroad Company at their shops in Altoona. The car was designed to meet the requirements of the Federal department in transporting test weights and other apparatus necessary for determining the accuracy of scales.

UNITED STATES BUREAU OF STANDARDS' TEST WEIGHT CAR, NO. [illegible] PENNSYLVANIA [illegible]

UNITED STATES BUREAU [illegible]

The general construction of the car is the same as the Pennsylvania railroad standard X-25 box car, minor changes being made to the [illegible] such as the application of end [illegible] at the [illegible] end, windows and a [illegible] and the strengthening of the underframe by means of body bolsters thereby raising the capacity to 140,000 pounds.

The backbone of the underframe consists of a center girder composed of two fish-belly type center sills 20 inches deep between cross bearers and tapering to 11 inches in depth at a distance 22 11/16 inches back of the center plate. The sills have 4-inch flanges, top and bottom, being additionally reinforced at the lower flange by two [illegible] [illegible] inside of the center sills [illegible] between body draft lugs, which are incorporated in the center plate reinforcing casting, and also by two 3/8 inch plates, which are riveted to the bottom horizontal leg of the center sill reinforcing angle and the lower flange of the center sill, and are continuous between body bolster bottom cover plates. The center girder is further reinforced at either end by a steel striking plate and front draft lugs combined, a cast steel spreader at crossbearers and pressed steel spreaders at all intermediate diaphragms.

The crossbearers and [illegible] bolsters are each composed of two cast steel diaphragms and two cover plates, one at the top and one at the bottom. The diaphragms are ⅜ inch thick and have 3½ x 3¼-inch top and bottom flanges, respectively. The crossbearer cover plates are ⅜ inch thick and the body bolster cover plate is ½ inch thick, all extending across the center sills and riveted to the flanges of the diaphragms, which in turn are riveted at either end to the center sills and side sills. A cast steel side bearing is secured to the bottom cover plate of the body bolster, while at the extreme end is a reinforcing casting, which also acts as a roping iron and jacking casting. The drop forged center plate is secured to the flanges at the center sills as well as to the center plate reinforcing casting, which ex-

end sills are secured to the striking plates and at either end to cast steel push pole pockets and corner castings, which are in turn riveted together and secured to the bottom member of the side truss.

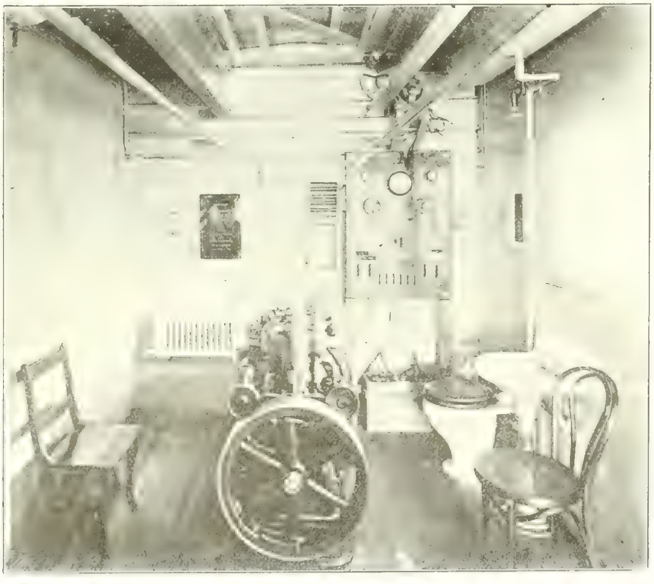
The diagonal braces are of U-shape sections, 8 inches in width and ⅜ inch thick, with 2½-inch flanges pointing downward, but at the ends they are flattened out and secured to the top flange of the center sill and to the corner construction. The side sill or bottom member of the side truss runs continuously between the end sills and is composed of 4 x 6 x ⅜-inch angle and a 4 x 3½ x ⅜-inch bulb angle, which are riveted together, back to back. The short leg of the angle points towards the center line of the car and the bulbed leg of the bulb angle points outward.

containing the depressions which form the posts, the center sheet overlapping and forming the cover plate. The opposite or "A" end has double swinging end doors which open outward, allowing an opening of 6 feet 9¾ inches and 8 feet 6 inches in width.

The design of an open end car necessitates a door frame of unusual strength and adaptability to the many functions required of it. The door frame is composed of Z-shape sections, which form part of the corner posts, the end plates and make possible the weather stripping around the sides and top. The vertical members of the door frame are riveted to the end side sheet, while at the top and bottom convenient corner castings join the relative parts and also insure the frame against excessive wearing. A door post is formed by the addition of a second vertical Z-shape section, which is 10¼ inches deep and ½ inch thick. This section is riveted to the web of the door frame and the end side sheets and extends up to the roof supporting the end door frame corner casting, which ties the top and sides of the frame together, as well as acting as a seat for two 5-inch H-beams extending across the top of car.

The roof is of standard all-steel construction, P. R. R. design, turned down over the edge and riveted to the vertical leg of the side and end plates and supported by bath-tub type carlines spaced 3 feet 9½ inches apart.

Besides being equipped with the usual box car side door, this car has an additional swinging side door located 8 feet 9½ inches from the "B" end of the car. Both sliding and swinging doors have been equipped with locks so that they may be operated from the inside or outside of car.



INTERIOR OF [illegible] WEIGHT CAR OF UNITED STATES BUREAU OF STANDARDS.

[illegible] the center [illegible] the car 9 inches, thus reinforcing a vital point in the girder.

There are six intermediate diaphragms on either side of the car, four of which are located between crossbearers and one midway between the crossbearer and body bolster, at either end of car; they are 6¾ [illegible] deep and [illegible] acting as stiffeners for the bottom member of the side truss and supports for the brake rigging. The end sill at the "B" end is a Z-shape plate, ⅜ inch thick, extending the entire width of the car, and which binds the end and side construction together. The sill at the "A" end, which is the door end, is somewhat different in shape, as it also performs the function of threshold plate for the end doors. The

The superstructure is composed of an outside sheet of steel and an inside lining of wood. The steel superstructure is made up of a series of ⅛-inch sheets for the sides and ¼-inch sheets for the ends, in which U-shape posts are pressed integral in one end and overlapped by the adjacent sheet which forms the cover plate for the post and presents a smooth outside surface. The post portion of the sheet is 2¾ inches in depth and 4 inches wide at the back. The side sheets also have a 2-inch flange, top and bottom, by means of which they are anchored to the bulb angle of the side sill and to the 4 x 6 x ⅜-inch eave angle or side plate at the top.

The construction of the "B" end is similar to that of the side, being composed of three sheets, the two nearest the sides

The swinging end doors are the same as used on P. R. R. standard automobile cars, being composed of ⅛-inch sheets conveniently flanged and reinforced so that the door is weather-proof when closed. Each door is supported by four hinges, which allow it to swing free of the opening. The doors are locked on the outside by top and bottom bolts, and by a locking bar on the inside located about the center of the door.

Four windows, two on either side of the car, are conveniently located for light and ventilation, the windows being designed so that they may be dropped flush with the window sill.

The car is lined on the sides and ends, as well as on the end door, with 13/16-inch lining, which extends to within 6 inches of the carlins.

From the two 5-inch H-beams before mentioned, is suspended a bridge and crane for moving and lifting weights. All machinery and interior equipment, such as generating plant, crane, weights and electric truck, have been installed by Mr. A. H. Emery, of Glenbrook, Conn.

Catechism of Railroad Operation

Disconnected Throttle Valve—Starting and Stopping a Train—Slipping—Lubrication—Finding the Dead Centers—Draft Appliances.

Third Year's Examination.

(Continued from page 338, October, 1915.)

Q. 280.—What would you do if throttle became disconnected while open?

A.—Would notify train crew so that they could be on the watch to help if needed, proceed, controlling the steam pressures to suit requirements and handle train with the reverse lever and brakes, at first telegraph office would notify the superintendent and master mechanic.

Note.—Would have to control steam pressures so that I could put reverse lever in center of quadrant when necessary to drift or to stop.

Note.—Some roads desire to have an engine coupled in when the throttle is disconnected open.

Q. 281.—What would you do if throttle came disconnected while closed?

A.—On a busy piece of road I would notify the officials and have the engine towed in to the terminal. If on a work train or where I would not be delaying any one and the engine was not needed badly, I would fill her up with water and blow the steam off, then take up the dome cap and connect the throttle up, put the dome cap on, raise the steam and come on.

Note.—It is a question whether it would pay to spend the time to connect up the throttle out on the road, but it can be done as soon as engine gets cool enough by twisting a piece of wire around bolt for a handle and putting it in place, then use a long piece of wire for a key, leaving the wire on bolt, put the dome cap back on and come in.

Q. 282.—What is the proper manner of handling engine to start a train and what signals are to be looked for?

A.—First see that all targets and signals are right ahead, then with the reverse lever down in the corner and the cylinder cocks open give engine a little steam, starting her gradually, and get the slack out of train one car at a time, when the train is all started I would look for the all right signal, and as engine gained in speed would hook lever up in rack and widen on throttle until the desired speed is gained and engine is working with all the expansion possible.

Q. 283.—What is the proper method of handling engine in stopping a train?

A.—Ease off on throttle, closing it gradually, then allow train to drift a distance until the slack has had time to run in and the draft rigging has had time to properly adjust itself before the brakes are applied.

Note.—The reason for gradually closing throttle is first it allows the brake rigging to adjust itself without a serious jar to the rear of train, and then in the second place it avoids a sudden strain on boiler which would be the result of the sudden gain in steam pressure, if the throttle were closed suddenly, and broken stay bolts, leaky seams and tubes would result.

Q. 284.—How would you handle engine that was slipping?

A.—Ease off on throttle and put reverse lever in corner, and if necessary would use sand, by closing throttle and opening sand valve, then open throttle gradually.

Note.—By having a light steam pressure follow piston the entire length of the stroke of piston, an engine is not as liable to slip, as with a high initial pressure and expansion.

Q. 285.—Is it advisable to have sand running on one rail only? Why?

A.—No. Because with one side holding and the other side free to slip it puts all the strain on the pins and rods on side that is holding and you are liable to break the pins or rods on that side of engine.

Q. 286.—What is friction and its result?

A.—Friction is the resistance of one surface to another surface moving in contact with it, and the result is heat.

Q. 287.—What is lubrication and its object?

A.—Lubrication, is the imposing of a non-frictional substance between two surfaces to cause the projections on them from coming in actual contact while in motion. Its object is to reduce friction.

Q. 288.—Why should strings of waste not be allowed to hang out of a box that is packed with dope?

A.—Because it will act as a syphon and run all the oil out of box.

Q. 289.—What examination should be made by the engineer to insure perfect lubrication?

A.—He should examine all oil holes to see that they are free and open, so that the oil will get to the bearings.

Q. 290.—Why is it bad practice to keep engine oil close to the boiler in warm weather?

A.—Because it thins it so it will not stay where you want it, and evaporates it, besides causing the best lubricating qualities to settle to the bottom of the can, and then it raises the temperature of the oil so that it is near the point where it looses its lubricating qualities.

Q. 291.—At what temperature does engine oil lose its lubricating qualities?

A.—At from 290 to 310 degrees Fahrenheit.

Q. 292.—At what temperature does the ordinary valve oil lose its lubricating qualities?

A.—At from 450 to 500 degrees Fahrenheit.

Q. 293.—At what temperature does the valve oil used on engines having the superheater, lose its lubricating qualities?

A.—At from 600 to 700 degrees Fahrenheit.

Q. 294.—In what manner would you care for hot bearings out on the road?

A.—Would see that the oil holes were clear and that the best lubrication was getting to the bearing, and would see that bearing was not binding. If necessary, would ease up on the bearing, and if a journal, would relieve it of the weight.

Q. 295.—Describe an accurate method of finding and getting an engine on the dead center.

A.—Pinch the engine ahead until the main pin is between the top eighth and the center, take a tram and from a center punch mark on some solid portion of frame, scribe across the rim of wheel, then mark the guides at forward end of crosshead; now pinch engine by center until crosshead is back of the mark you made on guides, then pinch engine back until the crosshead just comes up to the mark on guides, take the tram and from the center punch mark on frame scribe another mark on rim of wheel. Take a pair of dividers and scribe a mark parallel with rim of wheel, having this mark cut through the marks you had scribed on rim of wheel with the tram. Center punch the points at which the tram marks are intersected, then with the dividers find the exact center on the parallel line between the two tram marks, center mark this point then with tram in center punch mark on solid portion of frame, pinch the engine back until the other point of tram comes into the center mark on parallel line and engine will be on the exact dead center.

Note—It is necessary to pinch the engine by the center in this manner so as to get all of the slack out of the reciprocating parts and connections.

Q. 296.—What are the adjustable draft appliances in the front end of an engine?

A.—The petticoat pipe, or draught pipe, the diaphragm or deflector plate, and the nozzles are the draught appliances in the front end.

[illegible]

A.—Yes. So we can create a vacuum

[illegible] end and a forced draught on the fire.

Q. 2[illegible].—Can the exhaust nozzles be too small for the economical use of fuel and the working of the engine?

A.—Yes. If the nozzles are too small they cause much fuel to be drawn through the flues and it is carried out to the atmosphere unconsumed and a total loss. Then if the nozzles are too small they cause excessive back pressure.

Q. 2[illegible].—Is it practicable to have the nozzles too large?

A.—Yes, because engine will not work her fire and will not steam, that is, the draught will not be sufficiently strong to keep the fire at a high temperature, and consequently the necessary high steam pressure could not be maintained for any length of time.

Removing Paint from Iron.

Many experiments have shown that a paint softener made of one pound of lime to four pounds of potash mixed with six quarts of water will have the desired effect as quickly as many more costly preparations.

Silver Coating.

According to a recent patent, a fine silver coating can be produced by dissolving freshly precipitated chloride of soda, 1.1 parts to 10 parts of water, and adding to this solution 180 parts of spirits of sal ammoniac and then stirring in 800 parts of finely washed chalk. This mixture is applied and rubbed until it dries on the object being silvered, and the result is a brilliant deposit of pure silver.

Specific Gravity of Oil.

The specific gravity of oil may be found by taking a glass vessel and weighing it; then weigh into it one ounce of water, and mark the point where the water reaches to; then fill to this mark with oil and weigh it. Express the weight of the oil as a decimal part of one ounce, which will be the specific gravity of the oil. That of grease may be obtained in the same manner, pouring the melted grease into the vessel.

Melting Babbitt.

[illegible] fac[illegible]. If the metal is clean it is well to throw in a little dirt. It prevents the oxidation of the metal. Oxidation causes dross to form on the surface of the molten babbitt and consequently uses up a considerable amount of the metal. If the top of the melting pot is kept covered it will aid in preventing the forming of dross.

Department of Questions and Answers

Locomotive Valve Gears.

H. E. H., Mahanoy City, Pa., writes "Describe briefly the Stephenson, Walschaerts, and Baker valve motions, and the most important differences in each." A. A short description of these important contrivances cannot furnish other than mere hints as to their variety in construction, but it may be briefly stated that the Stephenson valve gear is actuated by two eccentrics, attached generally to the main driving axle, the eccentrics are furnished with straps to which rods are attached, the rods are connected, near the opposite ends of a radial movable link, the link is slidably attached to the lower end of a rocking shaft, the upper end of the rocker is attached to a valve rod which controls the valve. In controlling the direction in which it is desired that the engine should move, assuming that the piston is in the middle of the cylinder, the eccentrics are so adjusted that when the link block attached to the rocker, and on which the link may be moved upward or downward, is in line, or nearly so, with one or the other of the eccentric rods, the valve will be opened on the side necessary to admit the steam. This control is guided by the reverse lever, which is attached to a reach rod which in turn is connected to a lifting shaft to which the link is suspended and moves the link to the point desired. If the point of suspension where the link is connected to the lifting shaft is correctly placed, the adjustment of the eccentrics and rods may be arranged with a degree of exactness that cannot be surpassed in any other design of valve gearing.

In the Walschaerts valve gear the exact adjustment of an eccentric or crank set at right angles to the main crank is the primal necessity in its construction. A connecting rod attached to an eccentric or crank so fixed and so adjusted in point of length that it would reach exactly to the movable valve while the valve was in the central position would, by continuing the movement of the engine, continue to place the valve in the middle of the valve seat when the piston was at the end of the stroke. The Walschaerts valve gear mechanism is designed to move the valve the required distance from the center of the valve seat, and this is accomplished by the engaging of the valve rod by an intervening combination lever which is connected to the crosshead. The co-relation between the combination lever and a radius bar driven by an oscillating link which is moved by the eccentric rod, becomes the determining factor in moving the valve from the central position to the point desired. The moving of the valve toward the opening point by the use of the crosshead connection, as well as the intervention of the oscillating radial link, together with the use of the single eccentric or crank, are three distinct and separate features of this valve gearing, and their relation to each other forms a combination that is eminently suitable for locomotives.

The Baker valve gear resembles the Walschaerts valve gear in two particulars. The eccentric-crank, giving the valve its motion, is attached to the main crank pin, and a combination lever, deriving its motion from the cross head, gives the valve its position in relation to the steam ports. There is no radial link in the Baker valve gear. The circular movement to the eccentric rod, as also does the crosshead impart a similar varying movement to the combination lever. The crosshead movement is at the swiftest point when the eccentric crank motion is at the slowest, because they are at right angles to each other. The union link attached to the crosshead and the eccentric rod are connected to separate ends of a bell-crank. The end of the bell-crank attached to the eccentric rod describes an ellipse at an irregular velocity. This varying motion is conveyed through the bell-crank and the combination lever and valve rod to the valve. The result of the two irregular motions is that the valve travels rapidly at the beginning of its stroke and diminishes in speed when wide open. The reversing movement of the engine is effected by the eccentric rod being attached to a reverse yoke. When the reach rod is moved backward or forward it changes the position of the bell-crank and affects the movement of the valve with a degree of accuracy not obtainable in any movement passing through a shifting or oscillating link.

Signals and Duties of Trainmen.

S. W., Newark, N. J., asks:—What do the signals red, green, and white on railroads indicate? (2) If a train should be held up for a draw bridge what distance should one of the crew go back to warn other trains, and (3) what are the duties of a trainman and brakeman on passenger train service? A.—Red is used to indicate danger and at all times it means stop. Green has several meanings among which are an indication of safety when displayed on a semaphore, order board or the rear end of a train that has taken a siding. It is also used to indicate a section of a train when displayed in the proper place on an engine. Green placed beside the track on the engineer's side, and beyond a slow flag indicates that the track is all right for the usual speed. Green and white is used to stop a train at regular flag stops for passengers as are indicated on the time card. White is used to indicate an extra or special train when displayed in the proper place on the

front end of the engine. Yellow indicates caution at all times. Red, yellow, and blue have the same meaning on all roads, but green and white lights indicating whether a train is an extra or a section, and on the rear of trains the markers have the green displayed to the front and side, on all roads using the standard code of rules. In addition to these common indications green and white are used for various signals at the discretion of the railway officials. (2) When a train stops or is delayed on the main track a flagman must go back immediately with stop signals a sufficient distance to insure full protection. In daylight if there is no down grade toward the train within one mile and there is a clear view towards the rear of 2,000 yards—40 telegraph poles—he must go back at least 500 yards—10 telegraph poles. If the view is obscured and with no grade within one mile of the rear of the train he must proceed 1,200 yards—24 telegraph poles. If there is a down grade toward the rear end of the train he must go back 1,800 yards—36 telegraph poles. (3) The rules and regulations for trainmen vary in many details on the different roads. A passenger brakeman should understand the air brake and air signal systems, as well as the lighting, heating and water systems in use. Ventilation and heating and necessary supplies and tools should also be familiar to him. Audible and visible signals should also be known, and the calling out of stations in a voice that people can hear and understand is also essential.

Expansion of Air Pressure

H. [illegible], Sunbury, Pa., writes: I have been reading some technical matter relating to the law governing the expansion of fluid pressure, which I do not clearly understand. Could you tell me in plain words why a 20 lb. brake pipe reduction with the ordinary quick action brake results in the same brake cylinder pressure regardless as to whether the auxiliary reservoir pressure is 70, 90 or 110 lbs.? A. The reason is that the same number of cubic inches of free air or at atmospheric pressure leave the auxiliary reservoir in each case. In 110 lbs. gage pressure there is contained about 8.5 atmospheres, or if the reservoir under 110 lbs. pressure was expanded, it would fill a reservoir 8½ times its size to atmospheric pressure, therefore in order to find the number of cubic inches of free air in a reservoir filled with compressed air it is only necessary to multiply the capacity of the reservoir in cubic inches by the number of atmospheres it contains. The number of atmospheres is readily found by adding 14.7 (assumed as atmospheric pressure) to the gage pressure as registered and dividing by 14.7; thus 90 lbs. gage pressure will contain about 7 atmospheres, and 70 lbs. about 5.5 atmospheres. Disregarding all technicalities, if 1 lb. pressure escapes from an auxiliary reservoir under 110 lbs., it loses 1/110 of its volume; if 20 lbs. escape to the brake cylinder it loses 20/110, or 2/11. If the gage pressure is 90 lbs., a loss of 1 lb. means 1/90, or 20 lbs. will be 2/9 of the volume. If at 70 lbs. pressure, the loss of 1 lb. will be 1/70 of the volume, or 20 lbs. will be 2/7. Assuming, for an example, a 3,000 cubic inch reservoir, and applying the calculation, it will be observed that about the same number of cubic inches of free air leave the auxiliary reservoir whether the pressure is 110, 90 or 70 lbs.

$$3{,}000 \times 8.5 = 25{,}500$$
$$2/11 \text{ of } 25{,}500 = 4{,}600$$
$$3{,}000 \times 7 = 21{,}000$$
$$2/9 \text{ of } 21{,}000 = 4{,}600$$
$$3{,}000 \times 5.5 = 16{,}500$$
$$2/7 \text{ of } 16{,}500 = 4{,}600$$

Brakes Applying

C. W. B., Newcastle, Pa., writes:—What causes the brake on an engine (No. 6 E. T.) to apply when the brake valve is moved to release position and allowed to remain there when no leaks can be found from the pipes or exhaust ports and the correct pressures are carried? A. In this position of the brake valve handle, main reservoir pressure is free to enter the brake pipe and pressure chamber of the distributing valve, and when pressures are equalized the governor stops the pump, then a fall of pressure in the main reservoir, and consequently the brake pipe, occurs through the relief port in the governor and the warning port of the brake valve. The fall of pressure is quickly restored as the governor again opens and starts the pump, but the alternate increasing and lowering of pressure in the brake pipe may cause movements of the equalizing valve of the distributing valve especially if the governor is not very sensitive, and these movements may admit some pressure from the pressure chamber to the application chamber, and as the application chamber exhaust is closed, by the brake valve bing in release position, these movements will eventually build up enough pressure in the application cylinder to apply the brake. Even if the governor is sensitive and allows the pump to start promptly upon a reduction in pressure, a feed valve with a neatly fitted supply valve piston will tend to cause variations in the main reservoir and brake pipe pressure [illegible] plying the volume that is escaping from the feed valve pipe through the warning port of the brake valve, and this same variation in pressure may affect the distributing valve as explained before. There is nothing serious about this action of the brake as it is intended to be applied when the brake valve is in train brake release position.

Causes of Undesired Quick Action.

W. J., Harrisburg, Pa., writes:—When a case of undesired quick action develops on a train enroute, and a terminal brake test fails to again produce the disorder, what inspection should the locomotive receive in order to know that the locomotive brake equipment is not responsible for the quick action application when service was intended? A. If the tender has a quick action triple valve, it should be removed and tested on the standard test rack; if there is a distributing valve with a quick action cylinder cap on the locomotive it should be removed, thoroughly examined and tested on a shop test rack; the brake valve should be taken apart and the equalizing piston examined to know that it is not sticking from dirt or due to a shoulder worn in the piston bushing; the preliminary exhaust port should be gauged to know that it is 1/16 of an inch, the opening through the brake pipe exhaust fitting measured to know that it is ¼ of an inch, the equalizing reservoir must be known to be free from water, the gage pipe tee should be removed and the openings and connections examined for a possible obstruction, and the feed valve should be removed and tested on a shop rack to know that it will open and close on a 2-lb. or less differential. After all parts are again assembled the equalizing reservoir pipes and connections must be tested for leakage and the brake valve tested for the rate of equalizing reservoir reduction. This should be from 110 to 90 lbs. in from 5½ to 6 seconds, or from 70 to 50 lbs. in from [illegible]

Origin of the Extension Front.

The extended smoke box, which is a feature peculiar to American locomotives, was first applied as long ago as 1863 by Mr. E. M. Reed, who was then master mechanic of the New York, New Haven & Hartford Railroad. Before the extended front was introduced the diamond stack was almost universal on American locomotives, or the bonnet stack used in wood burning engines.

Years ago the writer had a conversation with Mr. Reed concerning the extension front, and learned that the idea of the inventor in making the change was that the use of an open stack would produce a fire draft that would make larger nozzles admissible.

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Scrap Tyranny.

[illegible] the profuse condition of certain scrap accumulations, and the G. F. observed: [illegible] than a gold mine to many railway companies, and there never was a better time than the present for exchanging scrap for new first class machinery." That was several months ago and meantime the depression that prevailed in contract shops [illegible] and we may expect soon to hear regrets from railroad officials that they failed to [illegible]

Hard times for railroad people appear [illegible] after economy that depression of business generally leads the way to, has dominated not a few railroad officials during the past five years. As hard times in ordinary domestic economy leads to the patching and renovating of old garments to defer the necessity for purchasing new ones, so it is natural that men in charge of railroad machinery make repairs take the place of renewals, at times when the earnings of the company are restricted. Thus prosperity, while wise in its origin, is frequently carried beyond prudent limits, and then it becomes a cause of waste.

Having the capacity to perceive the point at which it no longer pays to repair worn machinery, is a somewhat rare attribute, but there is no form of ability that pays railroad companies or machine owners better. There is a class of machine men who can never consent to send an intact article to the scrap heap, till years of repose in some place where it lay as obstructive litter, demonstrating beyond peradventure that it could never be used again. Engine 571 gets a new set of axle boxes, but two of the old ones are in pretty fair condition and are laid aside carefully under a vice bench to be handy for some other engine of the same class that may come in with a broken box. A discarded eccentric strap taken off 187 and not more than ¼-inch out of round is laid to repose beside the axle box and the adjacent space is filled with discarded feed pipes, nozzle tips, half worn piston rings, a cylinder head with a small crack in it, a few brake-heads, a sand box cover, and the inevitable oil box collar, besides a mass of promiscuous litter blindly regarded as being too good to throw away, make up details of the most wasteful form of saving.

A shop operated under the influence of this kind of saving sentiment is usually a museum of worn out articles, every recess and corner being filled with material that ought long ago to have passed through the cupola or forge. Good money has been paid out for tons of pig and bar iron whose place ought to have been taken by the scrap stored away under the pretense of being available stock. Stuff of this character is never available when wanted, and its individuality is only seen at the annual resurrection caused by stock taking. A predilection for preserving half-worn articles is an imminent and expensive habit, but a foolish one, keeping articles whose pattern has been changed is infinitely worse. In this case, casting houses and store rooms are littered with articles kept on hand because they have not been used and never will be. A vague hope is entertained that rough castings and forgings of this character [illegible] but successive annual stock takings pass and they all remain on hand, showing apparent plenty at times, in the presence [illegible] house of obsolete practice it presents to the eye! Cylinders, patterns that have not been used in a dozen years, oil boxes that this generation has not seen in use, and hundreds of details whose purpose the old pattern maker scarcely remembers, are still preserved because the patterns have not rotted out, but all this time the pattern house is so badly overcrowded that searching for a pattern not in regular use, entails hours of diligent labor.

This predilection for preventing the scrap heap from receiving its honest dues is not confined to rolling stock details or small parts of machinery. After many years it was finally decided to get a new planer in place of the old large one that had toiled indecripited long after trust and usefulness had departed from its operation. The new planer was placed where the old one had stood for a time beyond the memory of the oldest inhabitant. But was the old planer broken up? Not much. It was moved to the corner of the shop, for the purpose of being used for odd jobs, and it is continuously in the way, and the work done on it needs so much hand finishing that the jobs cost double what they are worth. The 12-inch lathe that became too shaky for turning was transformed into a bolt cutter, in which capacity it does not prove a shining success, since the product costs half as much as a new machine could have been got for and the tool will never do half the work done by a good bolt cutter.

Mistakes made in respect to the persistent holding on to obsolete and unsuitable tools are scarcely so serious in their consequences as holding on to locomotives that have become unsuitable for the service of the road. Worn out engines are hard to sell to advantage and many roads cannot afford to cut up good locomotives because they have become too light, but on the other hand, no extensive repairs should be expended on engines that have outrun their usefulness. When engines that have become too light for any but special service on a road require new boilers and cylinders, it would in nearly all cases be the course of wisdom to cut them up. The roads that follow this practice are those that are in the most flourishing condition. The same precept applies to the repair of cars.

Automobiles Crossing Railroad Tracks.

In one of Sir James Barrie's stories there is the account of a boy who in taking a near road across the country preferred to clamber over steep rocks and slide down dizzy precipices because there was a better chance of getting his neck broken in that way. This peculiar state of mind seems to have an abiding place in the thick skulls of many of the reckless American automobile drivers. Mr. C. W. Galloway, general manager of the Baltimore and Ohio Railroad Company, has

been taking particular pains to ascertain the degree of caution exercised by the automobilists who have occasion to cross the company's railroad tracks. As an example of the results of the observations, a crossing at Uniontown, Pa., might be taken as an illustration. One day last month, out of 729 automobiles crossing the tracks at a certain point, 28 were stopped to ascertain whether or not a train was approaching, 24 of them being stopped by a train using the crossing, and of the 701 violations, 505 of these vehicles were not even slowed down. In 52 instances the drivers looked in one direction while 542 did not look at all. There were but 135 drivers who looked in both directions before crossing the tracks and 470 machines crossed without regard for safety.

That there is an increase in accidents under such careless conditions is not to be wondered at, the increase in the company's railroad crossings last year being 29 automobiles struck by trains, and 23 more deaths than the record of the previous year. The publicity department of the railroad are doing their best to present the appalling figures to the public, but the mad rush goes on, and it would seem that full speed must be maintained and those who cannot see in their mind's eye the open coffin and the quiet cemetery rush on to their doom. The departments of correction in municipalities usually deal severely with would-be suicides, who, it must be admitted are of unsound mind, and we are not without hope that the strong arm of the law will some day reach out and stop the automobilists at railroad crossings on the ground that the general mass of them are in such a state of mind that they do not know enough to take care of themselves.

Sudden Revival of Freight Traffic.

The railroads of the United States have suddenly become flooded with more freight than they can handle and already we hear the oft repeated advice—purchase more cars. The Erie carried the largest volume of freight in its history last month and all the railroads east of Chicago are hauling all the freight that their motive power can handle. Steamships are being turned unloaded, loaded and started on the return voyage in two or three days. As the government through the Folette act has badly crippled the shipping, we now hear the demand repeated that the whole maritime business be taken hold of and managed by government officials. There is also a demand that the Interstate Commerce Commission prevent shippers from delaying the movement of cars. The real trouble with the railroads is that they lack terminal facilities for handling the traffic suddenly imposed upon them.

Some years ago when there was a sudden revival of freight business laws were enacted inflicting reciprocal demurrage, but this did no good. Only shippers of the various regulating bodies throughout the country are surprised by what is occurring, and for which they are responsible more than the railways. The people who are dependent upon the free movement of the railways' business, and whose opinion has supported the various measures which have prevented the railways from being in position to increase their facilities betimes, are now in a way to learn what the policy may cost them. They have saved on rates and risked their profits.

Personnel of Grievance Committees.

We have recently heard complaints that certain committees appointed to interview railroad officials concerning grievances labored under by fellow employees, have not been so well treated as they expected. We believe complaint of this kind are very rare and depend much upon the character of the men forming the grievance committee.

The writer once formed the object of a committee appointed to wait upon a railroad president to request that a roundhouse foreman should be discharged. The least sensible man of the party, assumed the duty of speaker and he began by telling that the engineers and firemen had decided to stop the operation of the road unless R. H. Foreman Bryant was discharged.

"What is the matter with Bryant?" asked the president. "He takes nobody's advise," was the answer, "just acts as he pleases."

"That appointment was made on my advice," said the president. "I had got tired of you fellows running the locomotive department, and I had an idea that Byrant would keep you in your places. Go, or it will be worse for you." They went quite meekly.

The late C. Warman took a very keen interest in the grievances of railroad men, but was very outspoken about real and fancied grievances. On one occasion he said:

"Brothers, when you send a committee to see the 'Old Man,' pick out the best men on the whole road, men who have good records of service to the company, and whom you are sure the officers respect and will listen to. Don't pick out men noted for talk or bluster, and whom you know are obnoxious to the officials, who by their very manner will offend most men and put them on the defensive. Send gentlemen to meet gentlemen, and business men to do business; send them to argue your case, make offers, open negotiation and make contracts as other business men do, not to bluff and bluster, and threat and brow beat to secure that which reason could obtain. The best engineers and firemen on the road are none [illegible] argument."

Killing United States Shipping.

For years a certain class of cheap politicians achieved thriving renown by promoting laws that injured and embarrassed railway companies; but their industry in that line becoming tedious, one of their leading iconoclasts, La Follette, succeeded in having a measure passed by Congress which added grievous burdens to American shipping. The American shipping interests labored under burdens carried by the shipping of no other country, but La Follette and others of the same type proceeded to impose new burdens that have had the effect of what is equivalent to break the back of the patient animal of commerce.

When the La Follette measure, known as the Seamans' bill, was under consideration in Congress, strong objections were urged against it by various business organizations, but the protests were ignored. The most objectionable feature of the law is that which requires the crews of vessels flying the American flag to be capable of speaking English, which means that only high priced persons must be employed. This imposes burdens upon American ships that makes competition with the ships of other nations impossible, at least good business men figure out that such would be the case.

The Pacific Mail Company, which is the largest owner of ships flying the American flag, was likely to be harder hit than any other by the new law, so that company lost no time in selling the principal part of their ships, while they were able to do so at a profit. This sensible business proceeding has been briefly discussed by William G. McAdoo, Secretary of the Treasury, and by William C. Redfield, Secretary of Commerce. These high United States officials appear to have been warm supporters of La Follette's seamans' bill, and are both disgusted with the action of the Pacific Mail Company in selling their ships. Now these gentlemen are promoting a scheme for the United States Government to become the owners of a merchant marine. Should this scheme be carried out the American people would be called upon to pay the losses that will result from the government ownership of vessels engaged in the nation's commerce.

It is likely enough that the prominent politicians who think themselves competent to manage the marine interest of the nation, may be permitted to have their own way for a time, until the people become thoroughly alive to the iniquity of government meddlers with the business of the country, then there may be a change to better conditions by submitting the [illegible] qualified by education and experience to safeguard the maritime interests of the country, a Commission similar to that of the Interstate Commerce Commission.

Charges for Transportation.

[illegible] days when the world was hearing many sorrowful tales about "Bleeding Kansas," the country which now constitutes that prosperous state, was almost destitute of railroads, and farm produce had so little value that corn was frequently burned as fuel, being cheaper than coal or wood. In those days corn rarely brought more than ten cents a bushel and wheat 25 cents a bushel. A curious anomaly about these Kansas people was that when sufficient railroad mileage was given to them to make transportation cheap, they displayed extraordinary readiness to pass laws restricting the rates that railroads were permitted to charge for carrying freight.

People whose business is to raise farm produce have always been noted for short sightedness in calculating the cost of various operations connected with the business of the country. A farmer with a wagon and pair of horses conveys a load of produce to a neighboring town, and looks upon the operation as being worth [illegible] days pay for man and team, the cost of same being set low, when such work has to be hired and when put at the sound basis of transportation the ton mile. To carry freight on a wagon over country roads averages 30 cents a mile, and frequently much more, when the roads are soft or hilly. In the old days stage coach proprietors rated the cost of carrying a passenger at 10 cents per mile. We are not aware that any railroad ever charged more than half the fare of stage coaches.

The prevailing charge made by rail[illegible] cent a mile per person and one ton of freight is carried for one cent a ton mile or less, yet politicians have no difficulty in raising public indignation against railroads for unreasonable charges.

Show Meeting Orders to Fireman and Brakemen.

[illegible] That duty may not be mentioned in the book of rules, but it is the injunction of good sense. If you have an order to meet [illegible] the meeting point, so that the steam won't raise the pop valve. If the engine is a [illegible] pressure up to the meeting point and in either case, if the engineer, through forgetfulness, pulls past the meeting point the [illegible] engineer's dignity to mix up a little sociall[illegible] with his fireman. In this way it [illegible] If we were making train rules we would make the practice of showing the fireman the meeting orders compulsory. The same rule ought to apply to the conductor in regard to his brakemen.

We are all familiar with serious collisions that happened owing to engineers and conductors forgetting orders concerning meeting points. Had firemen and brakemen known of the orders many of the accidents would have been avoided.

Some of the men concerned may object to follow the practice recommended. Better take time to do this rather than have rolling stock destroyed in collisions and human life blotted out unnecessarily. Do your best to keep your fireman posted.

Proper Shop Equipment.

We have listened to a great deal of vague talk about the requirements for doing work cheaply in railway shops, but we think the most important requisites are first-class tools and efficient mechanics to operate them. It is right and proper to have first-class tools to begin with, but tools wear out and worn out tools ought to be replaced by new ones before the output suffers from tools that rightly belong to the scrap heap.

A retired shop foreman, who was second to none in managing a fine repair shop, writes to us: To keep 100 locomotives in fair running shape, the shop should at least have the following tools: 4 16 or 18-inch lathes; 1 36-inch lathe for packing, etc.; 1 48-inch lathe for driving boxes, small tires, etc.; 1 wheel lathe; 2 10-inch lathes and one Fox lathe; 2 shapers; 1 8-foot planer; one planer large enough for frames; 1 universal radial drill; 2 Post drills; 1 milling machine, and 2 slotting machines. He recommends that a full set of small tools be bought from standard makers. That, he holds, will be much more economical than getting just enough to start with, and then making inferior tools in the shop at high cost.

Testing Locomotive Engineers on Signals.

Some of the [illegible] are constantly testing the engineers with surprise signals. The signals are flashed which compel the engineer to slow up or to stop without any reason. If the engineer fails to see the signal he is told at the end of his trip that at a certain point and a certain moment of his run he failed to obey a signal. Thus admonished he is made more alert. The training is continued until it becomes practically impossible for the engineer to pass signals without heeding them.

Such testing is regarded by many railroad men as a necessity. It keeps the engineers ever on the watch for signals, so that in a moment of real danger there is no likelihood of a failure to act properly. Some psychologists assert that the training makes it impossible for the men to fall into the habit of noticing certain stereotyped signals, and not recognizing others.

Legislation Tyranny.

Railroad interests have suffered grievously from over legislation, from the tendency of people to make laws for the guidance of their neighbors. No people in the world are so tyrannized over by vicious meddlesome laws as dwellers in the United States, yet it is exceedingly difficult to rouse the people, as a mass, to a realizing sense of the slavery imposed by legislators. The New York *Times* discoursing on "Half-baked legislation," remarks: "One would suppose that the passion for legislation and the enactment of fool laws in recent years were too notorious to be brought in doubt. Congress and the State Legislatures swarm with crank bills. The Kansas City Journal quotes from Mr. Henry M. Hyde some amusing or depressing details. In Massachusetts in 1914 'about every one in twenty of the citizens' was arrested; 176,000 arrests. In Chicago the percentage was about the same, and 'more than half of the 125,000 people arrested in Chicago in 1914 were charged with committing crimes which had no existence in 1894. Chicago has not grown worse. It is the victim of the pragmatical meddlers of the Legislature. The number of arrests has nearly doubled in the last seven years.

"The most virtuous or vicious place in the United States is the Missouri Kansas City. Its population is under 300,000. In the year ended June 30, 1915, the police made 55,000 arrests; nearly one of every five persons. If the good work of the lawmakers goes on, everybody in Kansas City may be sure of falling into the hands of the police once a year. Utopia on the map, perfection realized.

"'It is a felony in Texas,' The Kansas City Journal tells us, 'to play cards on a train.' Mr. Hyde gives some appealing instances of the legislative genius:

"'In Indiana men have been arrested for rolling a cigarette. In Illinois the cell yawns for a woman whose hat-pin projects more than half an inch beyond the crown of her hat. Again a bill was recently introduced into Congress providing a penitentiary sentence for any man who publicly exhibits a clock which is either fast or slow.

"'Another bill provided a term in the penitentiary for any man who should put his feet on the desk while dictating to a young lady stenographer.'

"Will there ever be a reaction against the making of superfluous statutes without [illegible]

The Aristocratic Piston.

Particulars have recently reached us of a most destructive accident that happened to a powerful locomotive by one of the piston rings falling into the counterbore. Disaster overtook the cylinder and tumultous ruin mastered the engine. Such an accident is due to a serious blunder on the part of the machinist who put in the piston, but it is one which happens more frequently than the mechanical railway world is aware of.

The fitting of a piston to a cylinder does not involve mechanical skill of a high order, but it calls for the employment of a careful, conscientious mechanic. Our tendency towards hero worship makes us believe that the piston is the heart of the steam engine. Until that element was invented all attempts at making a workable steam engine were failures. An injury happening to the piston, which might not be serious to another part renders the whole engine useless. The engine may be of first class design, and may embody the least possible metal most judiciously distributed; the valve gear may be perfect in operation, and possessed of the most ordinary qualities, but if the piston is not perfect in its qualifications as a piston, the usefulness of the whole machine is proportionately impaired. The man who fits a piston so that a ring is likely to fall into the counterbore, is the same type as he, who will drive in the piston with an improvised battering ram, saying that friction does not count.

The purpose of the piston is to furnish a steam tight barrier that shall move with the least possible friction. If the cylinder and piston could be made perfectly round and true, the piston could be fitted just loose enough to move freely, and no packing would be required. The only friction in such an arrangement, would be that due to the weight of the piston and rod end in horizontal engine. But first the defects in friction, and second the wear of the metal in use, renders packing necessary; hence a piston consists of two principal members: the piston box and packing. The friction of the packing depends upon the pressure exerted against the rings to produce a steam tight joint against the cylinder walls and is independent of the amount of wearing surface presented by the rings.

Of all the details pertaining to steam engines, there is none in which simplicity, durability and certainty are so much demanded as in the piston; and it may be set down as a fact, that the simplest piston is the best. A plain, movable diaphragm, accurately fitted, and with two or three grooves around the edge, would answer every purpose if it were not for the wear of the metal; and the nearer we can approach this device in simplicity and effect, the less trouble there will be experienced with steam leaks within the cylinder, and also with cutting and wearing; in addition the cost of lubrication will be reduced to a minimum.

The most successful designers made the solid part of the piston so as to secure ample wearing surface, and they remember that a thick piston if properly designed, furnishes a greater proportion of surface for the support of the weight than a thin one. The solid part of the piston or the piston proper, is to be considered entirely separate with reference to strength, wearing qualities and general arrangement from the elastic or wearing portion. The packing in the piston is simply a concession to our inability to make and preserve a perfect and correct piece of workmanship.

Trifling Air-Brake Defects.

Air brakes are very often defective, through the men in charge failing to undertsand the extent of minor defects. Mr. G. H. Wood, general air brake inspector of the Santa Fe is credited by the *Santa Fe Magazine* with making the following interesting comment:

"A large proportion of brakes found 'cut out' in trains on being tested are found to be in first class condition, and in a great many cases they are the best brakes in the train. Trainmen cut out brakes that do not release as soon as others in the train, without waiting until the brake-pipe pressure has been raised high enough to release brakes having tight cylinders. We find men who have a hobby of keeping the caboose brake cut out, apart of sliding wheels, and others who cut out cars and bleed them in order to make a switch quickly at some point.

"It is necessary to require that all trains and transfers be fully charged on arrival at terminals, and that brakes be fully charged on arrival at terminals; and that brakes be fully applied in service before the engine is detached, in order to discover inoperative brakes where yard lines are not available. Enginemen and trainmen frequently fail to appreciate the importance of these instructions and defective condition of brakes result."

Working and Thinking.

It is no less a fatal error to despise labor when regulated by intellect than to value it for its own sake. We are always in these days trying to separate the two; we want one man to be always thinking and another to be always working. When that distinction is made, we call the thinker a gentleman and the worker an operator; whereas the workman ought often to be thinking and the so-called thinker working, while both of them ought to be gentlemen in the best sense. As it is, we make both of them ungentle, the one envying, the other despising his brother, with the result that the mass of the most practical form of society is made up of morbid thinkers and miserable workers. Now, it is only by labor that thought can be made happy; and the professions should be liberal, as there should be less pride felt in pecuniary employment and more in excellence of achievement. These were thoughts of that wise thinker and worker, John Ruskin.

Master Mechanics Association Business.

On another page we place before our readers a detailed report of the work which the Executive Committee of the American Railway Master Mechanics' Association have laid out for consideration and discussion at the next convention. Next year the association will meet in the forty-ninth convention, so that the organization is getting up into years; but there are no indications that the association is becoming weary of well doing and is inclined to rest and be thankful for the performance of past duties. The volume of work laid out for each convention has been increasing from year to year, and that arranged for the 1916 convention is greater than any previous arrangement.

Some of the subjects put up for reports are becoming hoary with age, and it is difficult understanding anything new or original to be brought out concerning them. Mechanical stokers and fuel economy are two of these venerable subjects that have been nearly talked off the floor, but still many interesting things can be said about them. We have no doubt that Mr. A. Kearney, who will prepare the report on stokers will do the subject justice, and that Mr. Wm. Schlafge will have many interesting things to say about fuel economy.

Some few of the subjects are strikingly new, such as Equalization of Long Locomotives, with Mr. S. G. Thomson as chairman; Dimensions of Flange and Screw Couplers for Injectors, which will be reported on by Mr. M. H. Haig; Design, Maintenance and Operation of Electric Rolling Stock, with Mr. C. H. Turner chairman of the committee. This committee will report upon a subject that is pushing rapidly into prominence, and the sooner the steam locomotive men make themselves familiar with the principles involved the better it will be for railroad motive power interests.

Against College Graduates.

economical operation of electric railway machinery have generally adopted the

graduates as far as possible, but now the

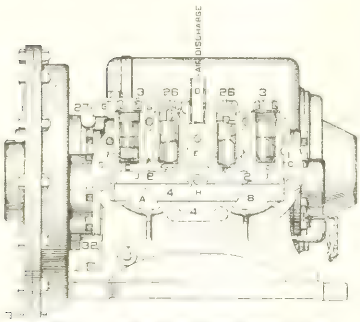
after protracted experience have come to the conclusion that the best man to run and repair electric locomotives are ordinary railroad mechanics. College grad-

Air Brake Department

Description of Motor-Driven Air Compressor—Duplex Pattern—Temporary Repairs—Broken Air Pipes with E. T. Equipment

Motor-Driven Air Compressors

[illegible] two years we have devoted considerable space to the description of air brakes for electric service, and wherever air brakes are used [illegible] air com-



[illegible]

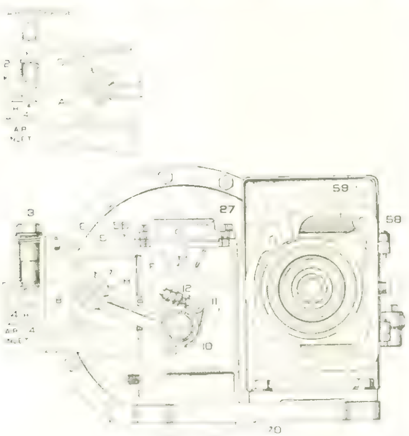
[illegible] The Westinghouse company furnishes several sizes and types of compressors especially de- [illegible] known [illegible]

[illegible] of the car, [illegible] ployed and [illegible] ted devices [illegible]

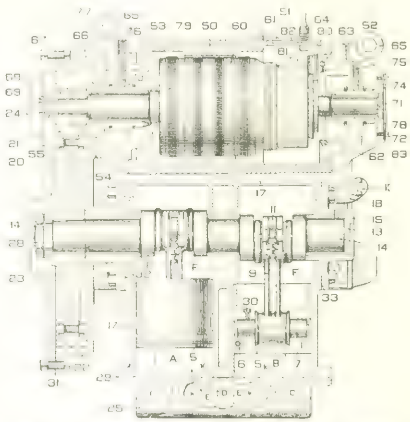
[illegible] trations are of the type D-EG, and [illegible] a horizontal section and [illegible] cover being sectioned to show the valve arrangement, and Fig. 2 shows an end view of the motor and an end view of the compressor section. These compressors are of the duplex pattern, the pistons moving simultaneously in opposite directions.

The air pistons of the compressor are fitted with piston rings, and as with the steam-driven compressors, atmospheric pressure is drawn into the cylinders through receiving valves as the piston moves away from the cylinder head, and is compressed and discharged into the reservoirs through discharge valves on the return of the piston, the difference between the air cylinders of steam and motor-driven compressors being that air is compressed only on one side of the air pistons. The air pistons obtain their motion from the crank shaft through the medium of connecting rods and they are attached with wrist pins. The motor is connected with the crank [illegible]

The motor is of the series type with an unsplit, annealed cast-steel magnet frame having a prolongation on the [illegible]



[illegible] MOTOR



[illegible] VIEW OF MOTOR DRIVEN [illegible] WITH COVER REMOVED

opening to permit of ready access to [illegible] of this opening is tight fitting for out door service and ventilated for indoor work. The armature bearings at the ends of the motor are carried in cen [illegible] and are provided with an oil well and filling hole arranged in a manner that the motor cannot become oil flooded.

Two of the field poles are part of the compressor frames and the other two are made up of laminations of soft sheet steel riveted together and bolted to the frame, thereby securing in place insulated and well protected field coils also.

The armature is built up of electric soft sheet steel punchings with accurately spaced slots in which are imbedded form-wound coils of uniform size.

The commutator is of liberal length, with deep segments insulated with the best grade of mica, and to prevent any movement that might damage the leads, special care is taken in supporting them from coil to commutator by a moulded insulating ring resting firmly on the commutator nut, while the coils are banded in the core and on the ends with steel wire insulated from the coils. The two brush holders are mounted on an adjustable cast iron yoke and are insulated from the yoke by fibre, fullerboard and mica washers. The carbon brushes slide in machined ways and are held in contact with the commutator by a coiled spring of bronzed ribbon, thus giving a uniform tension during the life of the brush.

These compressors are installed in the suspension cradles in a manner that they may be readily removed if repairs

are necessary, and it is not our intention to give a complete description of the compressors, as such literature accompanies any installation, but the same troubles from undue friction in the air cylinders, sticky air valves and overheating can occur as with the steam-driven compressors, and instead of stopping the pump, as with the steam compressors, the motor-driven will probably blow out a fuse, and instead of using a heavier than recommended fuse, the cause of the blowing out should be removed, for the use of the heavier fuse and a continuation of the disorder which causes it will likely result in a burning out of the motor.

This type of compressor is not intended for continuous service, as such machines are water-jacketed, therefore a certain time limit for operation is specified, and this varies with the pressure carried in the main reservoirs and certain other conditions and how this

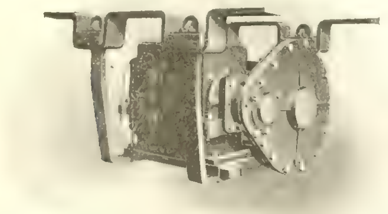


FIG. 4. MOTOR OF [illegible] COMPRESSOR MOUNTED ON SUSPENSION SADDLE.

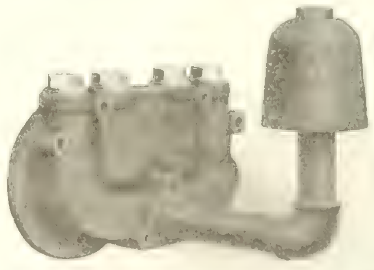


FIG. 5. COMPRESSOR AIR INLET.

is arranged can best be explained in connection with the compressor governor, a description of which will appear in a future issue.

Broken Air Pipes with E. T. Equipment

Some months ago several of our correspondents raised the question as to what should be done by a locomotive engineer to make temporary repairs to get an engine and train into a terminal in the event of an air pipe of the E. T. brake equipment breaking at some point along the road. In an effort to supply such information that will be of a practical nature we would call attention to the fact that many air brake men have worked out methods whereby a train can be charged and the brake applied when the E. T. equipment is in most any condition imaginable provided there is still a connection remaining between the air pump and the last main reservoir. We will ignore the theoretical side of this proposition so far as possible and recommend only such procedure as will not involve the taking apart of any of the apparatus.

In the event of a broken air pipe, connection can sometimes be made with air hose if the broken pipe is 1¼ or ¾ inch pipe provided that the broken ends can be removed and the two hose couplings will reach for a connection, that is, if the two broken ends of the pipe happen to be less in length than that of two standard air hose. In what is known as plugging a pipe, the safest method is to fill the pipe with waste for about one foot back into the pipe that is to be plugged and then hammer the end of the pipe partly shut and the pressure of air will then force the waste into an air tight joint.

Beginning with the governor pipes, if the pipe to the maximum pressure top should break off the pipe can be plugged to prevent a main reservoir leak and the excess pressure governor top will control the pump in the first three positions of the automatic brake valve, and if the valve handle is in lap position for any considerable length of time the compressor throttle can be partially closed to prevent too high a main reservoir pressure.

If the upper pipe connection to the excess pressure top breaks off the pump will be stopped whereupon the pipe should be plugged and a blind joint put in the lower connection either at the brake valve or at the governor.

If the lower connection should break, the break can be plugged to prevent a waste of air, and this will also render the excess pressure top inoperative, but the maximum top will control the pump in all positions of the brake valve.

If any of the gage pipes were to break it is only necessary to stop the leak of air by plugging the pipe, however, if the pipe happens to be to the equalizing reservoir gage hand a tight joint must be made and it will be somewhat difficult to make the exact amount of reduction desired.

In the event of a broken equalizing reservoir pipe a blind gasket should be inserted in the union at the gage pipe tee or the pipe plugged, the brake valve service exhaust port must also be plugged and when the brake valve is then used it must be moved slowly to emergency position and slowly back to lap position when the desired brake pipe reduction has been made, the object being to prevent the brakes from working in quick-action when the direct exhaust port is used and to prevent the brakes at the head end from being kicked off by the forward rush of air which might occur if the brake valve was brought back to lap position too quickly.

With a broken off reducing valve pipe, unscrew the adjusting nut of the reducing valve to stop the main reservoir leak and proceed. There will be no signal whistle or independent brake until repairs can be made.

With a broken off feed valve pipe, slack off the feed valve adjusting screw to stop the leak from one end of the pipe and plug the other end of the pipe and charge train with the brake valve partly in release position. Whether the excess pressure governor top will stop the pump depends upon whether the upper connecting or excess pressure pipe is open to the break in the feed valve pipe; if it is, a blind joint must be placed in the excess pressure operating pipe and the maximum top can be adjusted to maintain any pressure desired, but no excess pressure will be had for a release of brakes. The engine brake can be kept released with the independent brake valve, but if the engine brake persists in creeping on, the release pipe branch between the brake valves can be disconnected, to prevent undesired applications of the engine brake.

With the brake pipe broken forward from the brake valve, lap the automatic brake valve and plug the broken pipe, to stop the brake pipe leak.

With the brake pipe broken back of the brake valve branch, plug the pipe toward the brake valve and run the brake pipe pressure through the engine signal pipe to the train by connecting the brake pipe and signal hose at the pilot and at the rear of the engine. If the engine has no signal system, as in freight service, it is possible to charge the train pipe through the brake cylinder pipes by cutting out the engine brake cylinders and connecting the brake cylinder pipe at the rear of the engine with the brake pipe at the front of the tender. In this manner the brake valve can be allowed to remain on lap position and by moving the independent brake valve to application position the distributing valve will admit main reservoir pressure toward the brake cylinders, but instead of entering the cylinders it will flow to the brake pipe through the connection made between the engine and tender. The safety valve of the distributing valve can then be screwed down and the reducing valve can be adjusted to maintain any pressure desired in the brake pipe. This will be understood to be merely an emergency brake and the distributing valve must perform the work of a feed valve which it is not designed to do; it may, however, be sufficiently sensitive to prevent leakage from applying the brake, and to apply the brake the independet valve must be carefully moved to release position to exhaust brake pipe pressure for an application of the train brakes, without resulting in an emergency application.

This method of using the brake cylinder pipes and the distributing valve to make a connection to the brake pipe [illegible] also applies to a case where the brake valve branch of the brake pipe may be broken off or where the [illegible] be broken off at the brake valve when there is a feed [illegible] brake valve or in any case where the automatic [illegible] Some air brake men suggest the use of the dead engine feature for charging the brake pipe from the main reservoir [illegible] the dead engine feature which permits [illegible] fitting to supply the brake pipe, while we question the practicability of such connections, if the train is short enough so that it can be charged through this opening, an emergency brake will be [illegible] off at the brake valve.

Under ordinary circumstances a broken reservoir pipe at the brake valve can be temporarily overcome by plugging both ends of the broken pipe and using running position of the brake valve for a train brake release.

Another method of charging a train with a broken off brake pipe branch to the brake valve is to allow the automatic brake valve to remain in lap position, cut out the distributing valve with the stop cock in the supply pipe and remove the equalizing valve of the distributing valve and charge the train with the independent brake valve in quick application position. The brake to be applied by moving the independent valve to release position, or in emergencies by opening the brake valve cut out cock. With the return spring casing screw removed from the independent brake valve body, the valve handle will remain in quick application position, but as this involves the taking apart of some of the apparatus we do not exactly recommend it, but mention it merely as air brake information.

If the brake pipe is broken or burst under the tender, the signal pipe under the tender must be used to make a brake pipe connection by crossing the hose front and back of the tender. The signal whistle will be inoperative, but this is generally recognized as the correct method to be employed on a tender or car on a passenger train in the event of a broken brake pipe.

If the distributing valve supply pipe is broken off at the distributing valve, close the supply pipe stop cock and proceed to the terminal without an engine brake. If broken off between the reservoir pipe and the cut out cock, close the main reservoir cut out cock to maintain main reservoir pressure while the pipe is being plugged and then proceed without a driver brake.

With a broken distributing valve supply pipe on a lone engine, several methods for obtaining a brake on the engine have come to our notice; one is, if the distributing valve has a quick action cylindre cap is to remove the emergency side valve and the brake cylinder check valve and carry the brake valve on lap or in service position with the brake pipe drained, then when an application is desired, placing the automatic brake valve in release position will admit brake pipe pressure to the brake cylinders and apply the brake. The release to be made by moving the brake valve to emergency position. If the distributing valve has a plain cylinder cap, the cylinder cap gasket can be removed and a slot cut through the gasket between the brake pipe and brake cylinder ports and the brake applied and released in the same manner as when the emergency slide valve and check valve have been re- [illegible] cylinder cap.

In the foregoing it will be understood that the broken supply pipe is separated in such a manner that the two broken ends can not be removed and a connection made with two signal hose, for in case this can be done there will be no necessity for proceeding without an engine brake.

If the brake cylinder pipe is broken off at the distributing valve, move the independent brake valve to release position to prevent a waste of main reservoir pressure and at the first opportunity close the stop cock in the distributing valve supply pipe until repairs can be made at a shop.

If the brake cylinder pipe is broken under the tender, close the stop cock in the brake cylinder pipe at the rear of the engine and only the tender brake will be affected.

If the brake cylinder hose between the engine and tender are bursted, close the same stop cock until such a time as the hose can be removed without causing a delay.

In case of a broken brake pipe branch to the distributing valve, lap the automatic brake valve and plug the broken pipe toward the main brake pipe to prevent a brake pipe leak, then release brake on the engine with the independent brake valve and thereafter use the independent valve to operate the engine brake while the automatic brake valve is used to operate the train brakes.

In the event of a broken application cylinder pipe, plug the connection at the distributing valve and proceed. There will be no independent brake, but the automatic brake will not be affected otherwise that the engine brake can not then be released independently of the train brakes.

In the case of a broken distributing valve release pipe no repairs need be made, as only the holding feature of the automatic brake will be lost. The independent brake can also be applied in quick application position, but will release as soon as the valve handle is returned to lap or slow application position.

Should this occur in yard shifting service where the use of the independent brake is preferable to the automatic, the release pipe connection at the distributing valve can be plugged and the return spring casing screw removed from the independent brake valve body and the independent valve carried in release position until the correct repairs can be made.

We believe that the foregoing covers the subject fairly well and that a study of this matter will enable a man to bring a train to a terminal under ordinary conditions of broken air pipes on the locomotive.

Three 60-Ton Gas-Electric Locomotives for the "Dan Patch" Electric Lines

The Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Co., operating what is popularly known as the "Dan Patch" Electric Lines, has recently placed in commission three 60-ton gas-electric locomotives for freight, passenger and terminal service. The

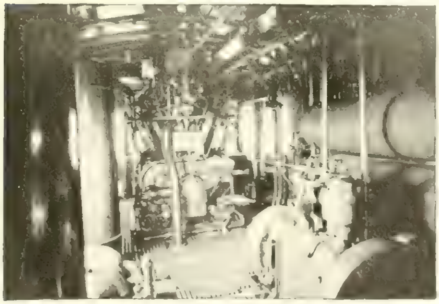
[illegible] LOCOMOTIVE

four gas-electric locomotives, as well as thirteen gas-electric motor cars which the railway company has purchased to date, were designed and built by the General Electric Company. It is interesting to note that this is said to be the first railroad in the world operated entirely with gas-electric service.

The railway extends south from the company's terminal building in Seventh street, Minneapolis, a distance of 107 miles to Mankato. Four through trains daily each way, one of which is a limited parlor car train, constitute the normal passenger schedule of the road. The limited makes the run of 107 miles, including four stops, in 3 hr. and 25 min.; while the other trains require 4 hr. and 5 min. for the trip. This service is supplemented by local trains between certain points of the line and the terminals, and by excursion trains during the summer season as occasion requires. One 70-ft. gas-electric motor car, seating 89 passengers, normally makes the run; when travel is somewhat heavy, a trailer is added to this; and for excursions and extra heavy traffic, a train is made up of trail cars drawn by a 60-ton gas-electric locomotive.

The new 60-ton locomotives are double ended and are designated type 404-G-120-4-GE-205-D. They are built with the box type of cab extending nearly the entire length of the underframe and have all the weight on drivers. Each locomotive is equipped with four GE-205-D motors. The truck clearances allow for 100 ft. minimum radius curvature. The power plant consists of two generating sets similar to the one used in the gas-electric motor cars. Only an engineer is required to operate the locomotive.

The box cab is of all-steel construction. The side posts and rafters consist of "T" iron and angles covered with sheet steel plates having lap and butt joints securely riveted. The generating sets and the controllers are installed in each end, while the auxiliary [illegible] section.



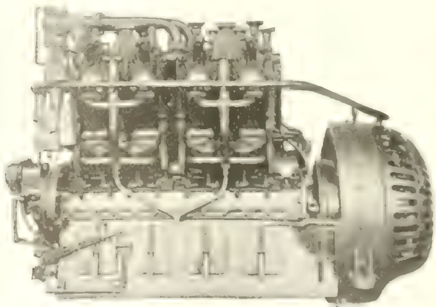
[illegible] LOCOMOTIVE

The underframe of the locomotive consists of two 10-in., 30-lb. section, longitudinal channels both for the outside and center sills. These extend the entire length of the platform and are tied together by heavy end frame cast steel buffers and bolster plates, each [illegible] end frame castings and bolted to the top and bottom bolster plates. The bolsters are built up of 12-in. by $1\frac{1}{8}$-in.

[illegible] LOCOMOTIVE.

steel plates, the top bolster being carried clear across the platform and riveted to all four longitudinal sills. The cast steel center plate castings are bolted to the bolster plates. Cross sills are riveted in where it is necessary to [illegible] frame.

[illegible] to the center sills. The draft gearing [illegible] tender couplers with 5-in. by 5-in. [illegible] plates. The entire platform is floored



[illegible]

[illegible] braced by [illegible] plates running the width of the locomotive and riveted to the longitudinal sills. In the cab this is covered with wooden slatted [illegible]

[illegible]

running board are bolted to the end frames and braced back to the side sills with bar iron.

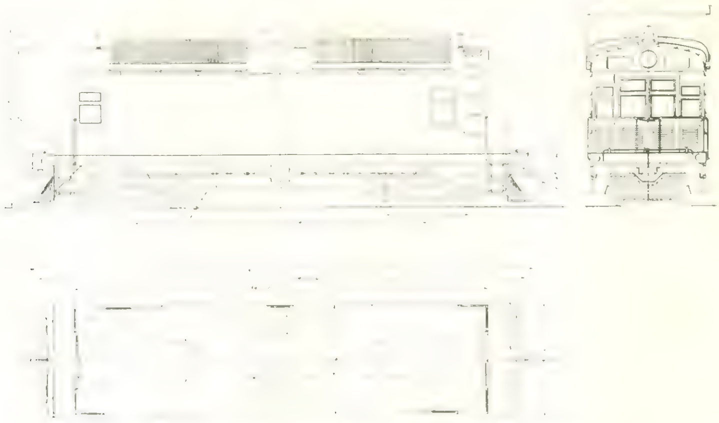
[illegible] are of the plate frame swing bolster type, designed for heavy freight work, and conform to MCB standards. The side [illegible] with cast iron pedestals, which are bolted to the frames and securely fast- [illegible]

built up of steel channels, rigidly braced and bolted to the frames with cast steel gussets. The truck bolster, of the swinging type, is built up of channels [illegible] pressed steel, and is supported on heavy triple semi-elliptic springs, Potter ends, hung by adjustable wrought iron swing links to the double side equalizer bars, which in turn rest on the journal boxes. The coil equalizer springs are cast steel tempered in oil.

The journal boxes, fitted with bronze babbitted bearings and wedges, conform to MCB standards. The wheels are solid rolled steel, 33 in. diameter, with MCB treads and flanges, 1913 contour. The axles are forged open-hearth steel, 6½-in. diameter between the wheels and with 5½-in. by 10-in. journals. The air brakes, with 16-in. brake cylinders, are the combined straight and automatic type, AVMS schedule, arranged double end control. The brake shoes are cast iron inside hung, the heads being supported by hangers. The brake levers and connections are arranged for easy slack adjustment.

Taking up the electrical equipment, each of the two gas-electric generating sets for the power plant equipment is composed of a 175 hp., 550 r.p.m., 8-cylinder, 4-cycle gasoline engine of the "V" type, which is direct-connected to a 600-volt commutating pole, compound wound electric generator with an outboard bearing supported by brackets bolted to the magnet frame. The cylinders are 8-in. diameter bore by 10-in. stroke. Ignition is accomplished with low tension magnetos and the control is so arranged that either one or both of the generating units may be used to operate the locomotive from either end, in accordance with the requirements of the trailing train load.

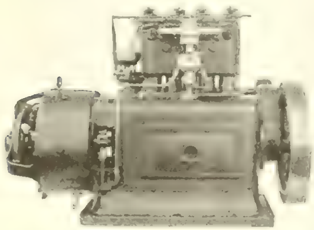
Throughout the engines are of the highest type of construction. The base is cast with suitable hand pole plates for inspection of the working parts, the crank case is cast iron and the bearings are babbitt lined. The cylinders are of cast iron and have removable heads. The crank shaft is of high carbon steel, oil treated, and the connecting rods are drop forged. The cam shaft is drop forged, with the cams integral, one on each side of the engine, the working surfaces of the cams being case-hardened and ground. The carburetor is the automatic, constant level, duplex type. Cooling water is circulated by a rotary pump, the water jackets being cast integral with the cylinders and heads.



[illegible] LOCOMOTIVE

There is also an auxiliary gas-electric set, the function of which is to furnish power for lighting the cab, headlights and train coaches, and for pumping an initial charge of air to fill the tanks and start the main engines. This set is started by hand. It consists of a vertical, 750 r.p.m., 4-cylinder, 4-cycle gasolene engine, which is direct-connected to a 5-kw., 65-volt commutating pole compound wound, electric generator. The cylinders are 3-in. diameter bore by 6-in. stroke, and ignition is effected by a high tension magneto. The air compressor on the 65-volt circuit is a two-cylinder motor-driven, railway type CP-28, and has a piston displacement of 25 cu. ft. per min. when pumping against a tank pressure of 90 lb. per square inch. Air is taken from the cab interior through screens and is delivered to the three reservoirs, each 87½ in. by 18 in. installed at one side of the cab in the center and connected in series, thereby affording an opportunity for radiation of heat and condensation of moisture before entering the brake cylinders. After starting the main engines, the governor on this motor-driven set cuts it out and all air is supplied by the air compressors on the main engines.

Mounted on the axles with nose suspension are four GE-205-D, 600-volt, series, commutating pole, oil-lubricated, box frame, railway motors having an hourly rating of 100 hp. each. All four axles are therefore driving axles, a



CARBURETER SIDE OF 5 K.W. GM-23 AUXILIARY GAS-ELECTRIC SET IN 60-TON GAS-ELECTRIC LOCOMOTIVES FOR "DAN PATCH" ELECTRIC LINES.

forged pinion being mounted on each armature shaft and meshing into a corresponding cast steel split gear mounted on the axle. The gear ratio is 58 to 17 teeth, a reduction of 3.41, which is especially adapted for freight and terminal switching service, as it affords maximum tractive effort at start and low speeds.

The control of the motor equipment is similar to that of the standard gas-electric motor cars, a type P-53 controller being installed in each end. Two motors are, however, connected permanently in parallel, and these two pairs, operated like single motors, are placed progressively in series and parallel. The controller provides seven running steps in series and six in parallel, without rheostats in the main circuit. There are also two additional points for shunting the series fields, making a total of fifteen efficient running points.

A single unit headlight, fitted with a 250-watt, 65-volt, gas-filled Mazda lamp, is mounted on each end of the cab. Double pneumatic sanders, a 40-lb. composition bell with pneumatic ringer and cord, and a pneumatic whistle are operated from either end of the cab.

The principal data and dimensions applying to the locomotive are as follows:

Total net weight equipped on rail—120,000 lbs.

Weight per axle—30,000 lbs.

Maximum tractive effort—32,200 lbs.

Length between knuckle faces of couplers—41 ft. 4 ins.

Length over cab—34 ft.

Height overall—14 ft. 10¾ ins.

Width overall—10 ft. 2 ins.

Total wheel base—24 ft.

Rigid wheel base—6 ft. 10 ins.

Track gauge—4 ft. 8½ ins.

Self-Made Men.

[illegible] a part "environment," influences our lives. The general idea of men who are too busy or too careless, to bestow much thought upon the matter, is, that from the time they have reached man's estate, they have moulded their own lives; that they have adopted such and such a business, have chosen from all the world the woman who is to be their life-long companion, have selected their special friends, and in short have ordered their whole career, and this is the reason we so often hear of "self made men." It is rather remarkable that it is only when a man rises from obscurity to some high position, or from poverty to affluence, that he likes to employ the term, or to hear it coupled with his name. Let his course have been in the contrary direction, and he at once disclaims having had any hand in the matter; then his own will was nothing; hereditary evil influences, bad luck, everything was against him; but, even as he speaks, he is only half convinced of the truth of his excuses; his conscience—if he has one still—whispers to him that he might have done better if he would.

But while courage and energy and perseverance are undoubtedly large factors in a man's success, they do not assure it; many a man possesses all three, and yet his career proves a failure, because his environment has been such as to neutralize them and defeat all his efforts to get on in life.

Portable Tools.

[illegible] adelphia, manufacturers of portable tools for railway repair and machine shops, issue a yearly catalogue unique in its kind. The illustrations beginning with views [illegible] showing about sixty other illustrations of the fine products described, forms admirable examples of the printers and illustrator's arts. The portable cylinder bar appears in a variety of forms and adapted [illegible] cylinders, pumps, steam hammers, blowing engines, air compressors, mining and hoisting engines, hydraulic and steam hoists, heavy housing, large wheels, and other appliances. Among the varieties are a standard boring bar fitted with attachment for taper boring. These are now extensively used in boring propeller hubs and taper crank pin holes, both in this and foreign countries. Other specialties include boring bars for lathe work, portable facing arms, circular planer tool for planing locomotive boxes, portable valve seat rotary planing machine, locomotive cylinder or dome facing machine, and a rotary flue cleaning machine. The latter is a compact and durable machine simple in operation and thoroughly cleans the hard adhering crust from boiler flues at the rate of eight to ten feet per minute. The machine is already in use on many of the most prominent railroads and is rapidly displacing the noisy rattlers. Among other machines of the portable kind are special portable milling machines which have the rare quality of doing particular kinds of work on machines after all the parts are assembled. The complete details of these and other machines are fully described and illus- [illegible] which may be secured by those interested by applying to the company's office, 1015 Hamilton street, Philadelphia.

Self Rotating Hammer Drills.

The Chicago Pneumatic Tool Company's Bulletins set forth with a painstaking degree of accuracy the details of their hammer drills which could only be acquired in the twenty years' experience as manufacturers of pneumatic percussive tools. Distinctive features of these drills are the valve that governs the reciprocation of the hammer piston and the rotation of the drill in utilizing the exhaust air from the rotation motor to operate the hammer piston. This is a real saving, as the air that operates the hammer piston merely passes through the rotation motor first. Several patents cover this ingenious contrivance. Bulletin No. 216 presents the complete details of the device, and the growing popularity of the company's pneumatic tools is the best proof of their superiority. Copies of the Bulletin may be had on application to the company's office, Fisher building, Chicago.

The Value of Motor Cars on Railroad Systems—Their Profit-Making and Transportation-Increasing Effect

[illegible] New York [illegible] remembered owing to the interesting character of the paper presented and for the dis- [illegible] "The Value of [illegible] Railroad Systems," by Mr. W. R. McKeen, of Omaha, whose work as a designer and builder of motor cars for steam railroad service is [illegible]

The paper begins: "A celebrated and very distinguished railroad authority, a high official on one of our greatest trunk lines, said: 'I would like to find some responsible operating official who could, with a reasonable degree of accuracy, tell me what it cost to haul a passenger one mile. I have never found one yet in all my experience.'"

It is not creditable to railroad companies that such ignorance should prevail concerning business vital to the prosperity of the companies, but the prevailing ignorance relating to this profit and loss [illegible] the reluctance of railroad managers to incur expenses for investigation likely to bring no direct profits. We have had considerable experience in operating branch lines and were quite prepared for [illegible] that his company operates three hundred [illegible]

When we have been operating a heavy locomotive to pull two or three cars with scarcely passengers enough to pay for lubrication, we have frequently raised the question: Why does not the company use [illegible] operation? In the paper referred to Mr. McKeen gives a detailed answer to that question when it proceeds:

"While it is true competent authorities are at times inconsistent in their expression of costs and profits of passenger train service, yet with the present standardizing of railroad accounts and a careful analysis of performance, operating forms—studied with regard to local influences and conditions—one can reach the facts, and I think I am safe in saying very few in any three-car passenger trains are operated at a profit—and branch line passenger trains and the passenger coaches on mixed trains are a source of financial loss every day, the whole year through. The heavy fixed expenses of passenger train operation are too high and too great to be offset by the limited and restricted passenger receipts: with mixed trains the situation is even worse.

"At first thought, it seems that to place a passenger coach on the rear end of a freight train, provide passenger seats, etc., and thereby have the advantage of additional revenue to help offset the operating expense of the freight train, is good economy and indicates a thrifty management. As a matter of fact, however, a [illegible] is a source of trouble, and represents false economy with no visible benefits other than being, as it is, an expedient, and a poor one at that. A mixed train's schedule that suits the passengers as to leaving and arriving time, is as a rule disadvantageous to the freight and stock shippers—the passenger stops slow up the freight time; the freight stops make tedious delays to the passengers—the train crews run into overtime—the service becomes uncertain, unreliable and is poor railroading at best, and never will be a source of profit and satisfaction.

"The financial success and universal popularity of the trolley car is not so absolutely the result of its operating on the city streets picking up passengers at street corners; on the most successful interurban electric systems the passengers are taken aboard at depots or central stations just the same as steam railroads take their passengers. The interurban cars stopping on city street corners is a detriment to electric car service, just the same as doing local work with 12 and 15 car steam through trains is bad railroad practice. The electric interurban cars with frequency of service, however, can be scheduled—their time between points, their leaving and arriving time, to suit the convenience and "*please the public*" and in consequence they get the business. Thus I reach the subject matter—*the gasoline motor car*—a transportation unit filling a natural want; meeting an already expressed demand by the general public [illegible] it offers ways and means of earning profits on branch lines, where the present steam service loses money.

"It has a great value to railroads operating mixed trains—same can be divided—two services, it is true, instead of one—but both on an acceptable as well as revenue earning basis; the motor car will *stimulate* increased passenger travel and [illegible] 50 to [illegible] 100 per cent. increase thereby is easily attained in six or twelve months, resulting in a handsome increase in passenger earnings; at the same time, the freight train is scheduled and operated to suit and please and economize on freight

[illegible] ON THE SANTA FE SYSTEM WHERE FREQUENT TRIPS ARE NECESSARY

business—cost of operation is reduced and the improved service always tends to better freight earnings.

"The branch line passenger business responds most actively to gasoline motor car service—the motor car can make road crossing stops, pick up one or two passengers at a time, stop more often and maintain the same average speed as the steam train; the absence of cinders, smoke and jar are attractive features—the equipment comforts over that of a steam train, or a jolt wagon on a bad highway or even an automobile are such by comparison as please and attract the public, and new business and stimulated increased travel is the usual result wherever gasoline motor car service is installed.

"Often on branch lines the public having one passenger service a day is much dissatisfied (and sometimes justly so); petitions and demands two services per day—the single service loses money, the railroad cannot consider doubling or trebling their present losses by putting on double passenger train service; and yet a disgruntled and 'sore' local public is not desirable—here then the benefit of gasoline motor car service is appreciated. The gasoline motor car as the new or second service, not only can operate at a profit, but frequently stimulates and increases the travel on the steam train. It is a constant complaint of motor cars—that they are too small—originally a 30-foot car could handle the business, then a 55-foot car was more than ample, next a 70-foot car, seating 105 people was thought to be more than ample, but history goes on just the same, the gasoline motor car is always too small, in other words, the gasoline car always increases and continues to stimulate and increase travel. The 70-foot car having stimulated and increased business beyond its capacity, we have recently inaugurated the gasoline double unit motor car service—the baggage, mail and express on the front or the power car and the passengers in the second car. However, where a 70-foot car is loaded to capacity, I believe additional service is the economical and preferable practice—the additional service continues to not only stimulate travel, but the rate of increase is also stimulated.

"While gasoline motor cars are more necessary to branch line service, they are also a source of much economy on main lines. One portion of a through line of a large railroad system was through a sparsely settled country—the fast through trains were doing the local work with the usual poor, irregular arriving time and general unsatisfactory service; a gasoline motor car service was inaugurated running about 40 minutes ahead of the through train, the express, mail, and passengers were collected from the small stations and deposited at the terminal, where the through train picking them up, carried same to destination—the motor car made reasonable profits—the local business increased about 60 per cent., but the improved time, the regularity of arriving at destination on time, the greater comfort and satisfaction to the through passenger service was of more real value than the increased profits of the operation sheet.

"I have in mind one branch line operated for 30 years without any profit from passenger business—the officials said the branch would never pay. With gasoline motor cars there are now two services daily with two coaches instead of one.

"I have in mind another sixty-mile road where the passenger train service showed a deficit ever since the road was built. A gasoline motor car was substituted for a steam train and the business was done at a profit, the operating expenses having been cut 60 per cent."

Mr. McKeen proceeded to give other examples of gasoline cars having changed the operating of certain lines from loss to profit. We are pleased to extend this publicity to Mr. McKeen's paper for we are persuaded that publicity alone is needed to move many railroad managers to adopt the use of gasoline cars.

Utilizing Scrap Steel.

During a recent visit to the Pacific Coast we learned particulars of how steel scrap is utilized in the repair shops of the Southern Pacific Company. They pile the scrap steel on a board, the same plan as that followed with scrap iron, and then a welding heat in a reverberatory furnace. Then they place upon the anvil block of the steam hammer a casting having an opening 12 x 10 inches through it. This casting is about 12 inches thick. In the hammer head there is a disc which fits the opening in the lower casting. When the steel is heated sufficiently, they drop it into the recess in the lower casting and strike it a blow with the hammer, then another lot of heated steel is added and driven as before, a process that is repeated until the opening is filled. When this is accomplished three or four small blows are struck by the hammer, the casting is raised and the ingot driven out.

By this process the mass of steel is thoroughly welded and the resulting ingots put under the hammer and drawn into any desired shape. A great variety of tools and rolling stock parts are made in this way, and in service prove as strong and durable as the same parts made from new steel.

The engineer who makes one pound of fuel do the work that previously took two pounds, is a greater benefactor of mankind than the man who makes two blades of grass grow where only one blade sprouted before his time.

The Efficient Foreman.

A personage whose qualifications seldom receive proper consideration before the appointment is decided upon, is the shop foreman. A very successful superintendent of motive power, talking on this subject, said: "Concerning the qualifications of a shop foreman, my practice has always been to select from the shop force, from the class that are active, energetic, conservative and progressive, with much character predominating, giving preference to the oldest men if merits are equal. In qualifications some knowledge of figures, reading and writing are essential, being able to comprehend orders clearly and quickly, mechanical skill, executive ability, systematic and thoroughness of work, and a full knowledge of what should be done, as well as how it should be done, are also desirable. Too much value can not be placed upon ability to impart knowledge to others, and it should be constantly the aim of the foreman to explain clearly and direct. Many foremen fail in this particular and attempt to perform themselves work that should be done by others. The old saying, 'as with the captain, so with the soldiers,' is especially applicable to shop foremen, and the efficiency of any foreman can accurately be judged by the performance of the workmen."

About Files.

In choosing a file, hold it between your eye and the light, the point of the file towards you, so that you can see the cutting edge of every tooth. Observe if they are all clean, smooth and sharp. If they are notched, cracked, uneven, and irregular, then that is a poor file. Examine the file for fire cracks, and observe if the file is all one color. If it shows a checkered appearance, it is uneven in temper, hard and soft in spots. Thick files are better than thin ones, and they stand recutting if desired. Low priced files are never good. The careful fitting of a handle to a file is good practice, and let the handle remain on that particular file.

A file should be treated the same as any other fine tool. One would never think of throwing a steel square or straight-edge into a drawer among other tools, and yet many files are treated in this way with the result that corners are dulled, teeth are broken off, and the file may be broken. Dipping files in sulphuric acid and water will sharpen up dull files a little. The acid eats off some of the steel and leaves the teeth sharper. This, however, does not last long. It is better to have the old files re-cut. If the file has been overheated it will never pay to have it re-cut. It always pays to buy the best that can be had, but it takes a man of experience to tell which is the best, and only a man of this kind should be allowed to do the purchasing.

Electrical Department

Westinghouse Electric and Manufacturing Company's Striking and Comprehensive Exhibit at the Panama-Pacific International Exposition

Undoubtedly every one of the more than eleven million persons who have so far been to the great San Francisco Exposition, as well as those who still have this treat in store, will be interested to learn that the mammoth electric locomotive mounted on the turntable in the Transportation Palace has received the Grand Prize, the highest award in the gift of the exposition.

This locomotive which, owing to its being mounted 12 feet from the floor at the intersection of the two main aisles of this most interesting part of the Exposition, completely dominates the Palace of Transportation, forms a part of the exhibit of the Westinghouse Electric & Manufacturing Company.

In addition to an extensive display of apparatus used in connection with the transportation industry appropriately grouped around the locomotive, the Westinghouse Company also exhibits in the Machinery Palace, and in "The Mine" in the Palace of Mines and Metallurgy and in additon has succeeded in getting several hundred other exhibitors to use Westinghouse motors in connection with their exhibits.

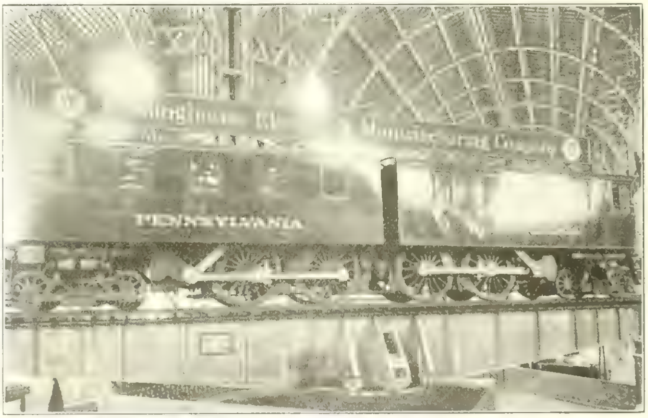
Placards prominently displayed around the locomotive inform the visitor that it is one of thirty-three 4000 h. p. 650-volt direct current double unit locomotives used by the Pennsylvania Railroad in hauling its trains in and out of the New York Terminal and was removed from service only for exhibition purposes. Upon its [illegible] which has recently been published in the technical papers, it was awarded the highest prize.

Mounted on a turntable that rotates once every 2½ minutes it has a majestic dignity that never fails to catch the attention of the visitor.

Another prize-winning exhibit was that of the well-known HL Control system for electric railways which was awarded the Gold Medal. This system is very clearly demonstrated by means of a group mounted on a rack with all parts in full view, connected to two 27½ kw., 600-volt "Baby" light-weight motors, themselves of particular interest, weighing only 1680 pounds.

In order to demonstrate the high contact pressure present in the switches used in HL and other forms of Westinghouse unit switch control, one of them is shown, with the side cut away to give a clear view of all the working parts, mounted [illegible] tached to the moving jaws of the switch. It is shown by this arrangement that the spring pressure against which the switch closes and which is available for opening the switch is 65 pounds, and that in additon to closing against this spring pressure, the switch exerts an actual contact pressure of more than 110 pounds.

To illustrate the application of the PK type of control, two racks, each containing two motors and an equipment applied to a drum controller are shown, the two being connected together through a train line so they can be operated from one master controller. Each rack represents one car and by operating the master controller, the action of the control and motor equipments in a two-car train can be fully observed. The Jury awarded to this type of control, the Silver Medal.



PART OF WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY'S EXHIBIT

Distributed around the base of the locomotive are a number of A. C. and D. C. railway motors of various types and capacities, and it is of interest to note that the Westinghouse Electric & Mfg. Company was also awarded the Gold Medal on its line of A. C. and D. C. railway motors, also its line of A. C. and D. C. generators.

Among the more interesting of the motors shown may be mentioned the pressed steel motor, 36 kw., weighing 2110 pounds; the newly developed 5000-volt direct current motor which has been in successful operation on this and even higher potentials, and the No. 412-A, single-phase, 25-cycle, 220 horse power used in the Philadelphia Paoli Electrification of the Pennsylvania Railroad which has just been put into service.

There is displayed around the space, a complete line of parts entering into motor construction, such as brush holders; armature coils; field coils; sections of which are cut out, showing the strap winding used; housings cut open to show the watse and oil gauging chambers; field coil springs and shields to prevent chafing, pressed steel gear cases as well as insulating cloths, varnishes and compounds used in the manufacture of this and other apparatus.

Following out the educational idea of the Exposition, there is a very practical exhibit of armature winding that always attracts those interested in electrical matters, consisting of a No. 306 armature with various sections at different stages of winding from the slot to the completed winding, permitting an inspection to be made of the method of winding, insulating details, building up of coil supports, the extra insulating strips whenever the coils cross to eliminate chafing, the U-shaped pieces where coil leaves the slot, and various other insulating details employed in the production of Westinghouse motors. By carefully examining this armature one can secure an excellent idea of the construction of modern electric railway apparatus.

Located near the attractively furnished office of Director of Exhibits, H. W. Cope, is a rack containing various samples

of line material for street railway and interurban lines including section breakers, insulated breakers and crossings, trolley frogs, cars and suspensions of various types, catenary hangers, strain insulators and other line material parts.

A case of insulating material including insulated and treated cloths, varnishes and different forms of the well-known Bakelite Micarta, which was likewise the recipient of the Gold Medal, gives the visitor a good idea of the best and most approved forms of insulation used in the manufacture of modern electrical apparatus.

The R. D. Nuttall Co., one of the Westinghouse interests, has on exhibit here a number of gears and trolleys of more than passing interest, which were awarded the Silver Medal.

The extensiveness with which the Westinghouse Electric Company enters the transportation field is clearly shown by this exhibit in the immense Palace given over by the Exposition to this great field, for in addition to the elaborate display of electric railway apparatus already mentioned, there is included apparatus for electric vehicles, mine haulage, gasoline automobiles, and power plant apparatus for supplying energy to transportation companies.

In the power transmission section of this exhibit, those interested in matters electrical find much to attract their attention, including a complete switchboard and accessories.

Undoubtedly the most striking feature of this part of the exhibit is a single-pole 300-ampere oil circuit-breaker designed for operation on a 165,000-volt circuit, the largest circuit breaker ever built—with a portion of the tank cut away, permitting one to enter and inspect the lining and contacts and general construction. In fact the tank is of sufficient size to accomodate several people at one time.

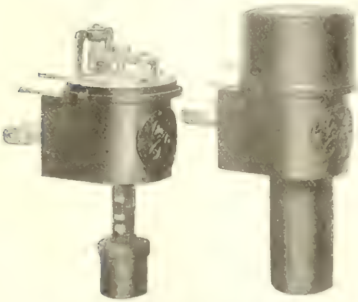
Railway lightning arresters are demonstrated in a very interesting manner with the aid of a 5 kw. transformer supplying 13,000 volts to a set of condensers and two adjustable spark gaps. By means of this apparatus high voltage, high frequency discharges are created and then dissipated by the arresters. The well-known type MP 1,000-volt arrester for car, line and station use, and the condenser type K, 600-volt arrester used for car or line protection, are thus demonstrated in a manner approaching actual service conditons.

Another distinctive Westinghouse product, the portable substation, is shown in a model built to scale, which is an exact reproduction of the car and all apparatus used in this important accessory to rail- [illegible] of special interest.

All of the exhibits are appropriately grouped around the locomotive as a center piece, each group pertaining to some particular branch of the electrical industry, the whole exhibit having been awarded the Gold Medal by the Jury of Awards as being the most attractive and complete exhibit in the Transportation Palace. This exhibit also is the headquarters of the Director of Exhibits, H. W. Cope, who has charge of all the Westinghouse Electric & Mfg. Company interests at the Exposition.

General Electric Company's New Type of Circuit Opening Oil Dashpot Relay

A new type of circuit-opening inverse time limit oil dashpot relay has recently been developed by the General Electric Company for use in conjunction with a



[illegible]

low voltage release for automatic, overload and low-voltage protection of alternating current motors up to 2,500 volts and 300 amperes.

The relay is connected in series with the line, the low voltage release across one phase in the usual manner with the low voltage coil in series with the relay contacts.

On overload greater than the current setting the relay, the relay contacts open-circuit the low voltage release coil and the motor is cut out of circuit. If the voltage drops to a predetermined per cent. of normal, the motor is also disconnected from the power supply.

This relay is mostly employed with motors using self-contained compensator control, but sometimes for switchboard service when both low voltage and time delay overload protection are required. Here series relays replace the secondary relays, current transformers and oil switch tripping coils otherwise required.

Current calibration is from normal to twice normal, and time adjustment from 10 sec. to 5 min. on 25 per cent. overload. The delay recommended, however, is about 15 sec. at the starting current of the motor. This affords ample protection to the motor against damage from overload or single-phase operation, but prevents the circuit from being opened while the motor is starting.

The new relay is a vast improvement over the one previously manufactured. The contact, dashpot and calibrating tube are inclosed by dust-proof stamped steel covers. Current and time adjustment are accomplished outside of the dash-pot simply with the aid of a screw-driver. The settings are constant, for an adjusting nut is locked in place after each setting is made.

Wet Rails.

An impression prevails among railroad men that rainy weather increases the resistance of trains and that more fuel is used in pulling trains when the rails are wet than what is required when they are dry. A statement to that effect having been made by a railroad official moved a well-known traveling engineer to institute investigations of the power used on wet and on dry rails. Scientific experiments were carried on for several months and it seemed to be proved beyond question that with wet rails the wheel resistance was about 20 per cent. less than when the rails are dry.

A general manager of a cable road having heard that statement made about the reduced wheel resistance on wet rails, made experiments for his own satisfaction, and found that the statement was correct. He explained the case by holding that when the rails have been washed by the rain there is less grit and sand left upon them to cause wheel resistance. This fact is readily observed also in stopping trains when the train will invariably run a considerable distance further when the rails are wet, although the retarding force of the brakes may be considerably increased to meet the expected emergency.

Westinghouse Grants Concessions.

Last month President E. M. Herr, of the Westinghouse Electric and Manufacturing Company, gave out the following [illegible]

"It has been decided to grant to all of our shop employes on check an average eight hour and forty minutes day instead of an average nine hour day, or a fifty-two hour week instead of a fifty-four hour week.

"In addition the company for the next calendar year, will grant a bonus to all shop employes of 6 per cent. on the [illegible]

American Steel Foundries' New Electric Steel Furnace

The American Steel Foundries has in- [illegible] electric furnace of the Heroult design at its Indiana Harbor, Indiana, plant for the production of extra quality steel castings.

Items of Personal Interest

[illegible] Pennsylvania with office at Columbus, Ohio.

Mr. George A. Smith has been appointed assistant shop superintendent of the Chicago Belt, succeeding Mr. Robert Smith, deceased.

[illegible] appointed assistant roundhouse foreman of the Oregon Short Line, with office at Pocatello, Idaho.

Mr. G. P. McLaren has been appointed division engineer of the Toronto district of the Canadian Northern, with office at Rosedale, Ont.

Mr. W. H. Fletcher has been appointed district master mechanic, District No. 1, of the Canadian Pacific, with office at North Bay, Ont.

Mr. Gordon Sproule has been appointed engineer of tests on the Canadian Pacific, with office at Montreal, Que., succeeding Mr. E. B. Tilt, resigned.

Mr. A. M. Hilborn has been appointed general car foreman of the Illinois Central, with office at Memphis, Tenn., succeeding Mr. E. A. Nix.

Mr. L. A. Cleary has been appointed general foreman of the Canadian Pacific, with office at McAdam, N. B., succeeding Mr. W. Wells, transferred.

Mr. W. H. Owens, formerly master mechanic of the Southern, has been appointed mechanical member of the valuation department of the same road.

Mr. W. A. George has been appointed roundhouse foreman of the Chicago & Rock Island, with office at Liberal, Kans., succeeding Mr. W. H. Graves, resigned.

Mr. A. W. McClelland has been appointed chief despatcher on the Northern Pacific, with office at Staples, Minn., succeeding Mr. A. M. Deverell, resigned.

Mr. R. M. Boldridge has been appointed master mechanic of the Apalachicola Northern, with office at Port St. Joe, Fla., succeding Mr. J. P. Dolan, resigned.

Mr J. E. Gould has been appointed master mechanic of the Charlotte Harbor & [illegible] succeeding Mr. W. H. McAnnis, resigned.

Mr. A. McCowan, formerly general car foreman on the Canadian Northern, has [illegible] Man.

[illegible] assistant shop superintendent of the Chicago & Rock Island, with office at Silvis, [illegible] moted

[illegible] car foreman of the repair yard of the [illegible] Transcona, Man., succeeding Mr J. [illegible]

Mr. H. Hulatt, has been appointed manager of telegraphs of the Grand Trunk, and Grand Trunk Pacific, with office at Montreal, Que., succeeding Mr. A. B. Smith, resigned.

Mr. F. O. Haymond, superintendent of the Bingham & Garfield, with office at Magna, Utah, has been appointed also superintendent of the motive power and car departments.

Mr. John R. Bowen has been appointed assistant road foreman of engines of the Delaware & Hudson, with office at Oneonta, N. Y., succeeding Mr. C. D. Perry, promoted.

Mr. E. Eley, formerly division car foreman of the Canadian Pacific at North Bay, Ont., has been appointed master car builder, eastern lines, with office at Montreal, Que.

Mr. E. Hacking, formerly car foreman on the Grand Trunk Pacific at Prince George, B. C., has been appointed general car foreman on the same road, with office at Transcona, Man.

Mr. C. R. Hening, formerly roundhouse foreman of the Michigan Central at Kensington, Ill., has been appointed general foreman of the machine shops at Michigan City, Ind.

Mr. J. H. Mahoney has been appointed foreman of the car department of the Cincinnati division of the Erie, with office at Marion, Ohio, succeeding Mr. W. W. Warner, transferred.

Mr. A. E. Eager, formerly superintendent of shops of the Canadian Northern at Winnipeg, Man., has been appointed assistant superintendent of rolling stock, with office at Winnipeg.

Mr. Curtis C. Westfall has been appointed engineer of bridges of the Illinois Central, with office at Chicago, Ill., succeeding Mr. Maro Johnson, assigned to special engineering work.

Mr. F. C. Carlson, formerly assistant master mechanic of the Texas & Pacific, has been appointed master mechanic of the International & Great Northern, with office at San Antonio, Tex.

Mr. Thomas Seften, formerly bridge inspector on the Intercolonial Railway, has been appointed government inspector on the construction of the Moncton bridge, with office at Moncton, N. B.

Mr. F. Mckay, formerly supervisor of bridges on the Canadian Northern at Toronto, Ont., has been appointed supervisor of bridges and buildings on the same road, with office at Capreol, Ont.

Mr. W. T. Montague, formerly engine house foreman on the Pennsylvania, at Brownsville, Pa., has been appointed assistant master mechanic on the same road, with office at Jersey City, N. J.

Mr. A. L. Graburn, formerly mechanical engineer of the Canadian Northern, at Toronto, Ont., has been appointed assistant superintendent of rolling stock of the Eastern Lines, with office at Toronto.

Mr. W. C. Smith has been appointed assistant mechanical superintendent of the Missouri Pacific, with office at St. Louis, Mo., succeeding Mr. J. E. O'Brien, who has been appointed mechanical superintendent.

Mr. A. P. McLure was elected general manager of the Lancaster & Chester Railway Company at the annual meeting of the directors, held last month. The company's main offices are located at Lancaster, S. C.

Mr. W. C. Moore, formerly master mechanic of the Ottawa division of the Canadian Northern at Trenton, Ont., has been appointed master mechanic of the Toronto district of the same road, with office at Trenton, Ont.

Mr. J. H. McAlpin, formerly locomotive foreman of the Canadian Northern at Winnipeg, Man., has been appointed master mechanic of the Lake Superior division of the same road, with office at Parry Sound, Ont.

Mr. C. E. Brooks, active superintendent of motive power of the Grand Trunk Pacific, has been appointed superintendent of motive power, with office at Transcona, Man. The duties of master car builder will also be assumed by Mr. Brooks.

Mr. L. B. Jones, formerly roundhouse foreman of the Macon, Dublin & Savannah, has been appointed general foreman on the same road, with office at Macon, Ga., succeeding Mr. W. B. Combs, who resigned to accept a government position.

Mr. A. C. Watson, formerly division engineer of the Pennsylvania Lines West of Pittsburgh, with office at Logansport, Ind., has been appointed to a similar position on the same road, with office at Cleveland, Ohio, succeeding Mr. E. F. McCrea, deceased.

Mr. R. C. Earlywine has been appointed assistant air brake instructor on the Chicago & Rock Island, first district, succeeding Mr. H. E. Reynolds, transferred; and Mr. Paul Willis has been appointed air brake instructor on the second and third district, succeeding Mr. Earlywine.

Mr. Irwin A. Seiders, formerly fuel inspector of the Philadelphia & Reading, has been appointed superintendent of motive power on the same road, with office at Reading, Pa., succeeding Mr. Samuel G. Thomsen, resigned, and Mr. Clyde C. Elmes, formerly assistant engineer of motive power on the same road, has been appointed assistant superintendent of motive power and rolling equipment, also with office at Reading.

Mr. Thomas Finigan, vice-president of Pierson, Roeding & Company, of San Francisco, was elected president of the American Electric Railway Manufacturers' Association, at the annual meeting, held in San Francisco, on October 6. Much satisfaction was expressed at the election for the first time of a Western

THOMAS FINIGAN

man as president of the association. The following were elected to the Executive Committee to serve three years, the first three to succeed themselves: Charles C. Peirce, General Electric Company, Boston; Henry C. Evans, Lorain Steel Company, New York; Daniel W. Smith, Peter Smith Heater Company, Detroit; Miles B. Lambert, Westinghouse Electric & Manufacturing Company, Pittsburgh, and A. H. Woodward, International Register Company, Chicago.

Mr. William H. Lewis, superintendent

WILLIAM H. LEWIS.

of motive power, Norfolk & Western, has been the recipient of many warm congratulations on reaching his seventieth birthday last month, being born on October 18, 1845, at Syracuse, N. Y. He began his railroad career as machinist apprentice on the New York Central in 1861, and worked as machinist on several of the leading western railroads. From 1869 to 1873 he was locomotive engineer on the Hannibal & St. Joseph. From 1873 to 1878 he was general master mechanic on the Northern Pacific, and latterly served in a similar capacity on the Oregon Short Line, New York, Chicago & St. Louis, and Chicago, Burlington & Northern. On July 1, 1897, he was appointed to his present position, and is hale and vigorous as ever and looks good for many years to come. He has been prominently identified with many of the leading mechanical and engineering societies, and was president of the American Master Mechanics' Association in 1903 and 1904, and is one of the best known and accomplished railroad men of our time.

Master Mechanics' Annual Reports.

At a meeting of the Executive Committee of the American Railway Master Mechanics' Association, held in September, the following subjects were chosen for reports at the next convention and committees appointed to carry on the work:

Standing Committees.

1. Standards and Recommended Practice: W. E. Dunham (Chairman), Supt. M. P. & M., C. & N. W. Ry., Winona, Minn.; A. R. Ayers, G. M. E., N. Y. Central Lines, New York City; M. H. Haig, M. E., A. T. & S. F. Ry., Topeka, Kan.; A. G. Trumbull, Asst. to G. M. S., Erie R. R., New York City; C. D. Young, Engr. Tests, Penna. R. R., Altoona, Pa.; G. S. Goodwin, M. E., C. R. I. & P. Ry., Chicago, Ill.; R. L. Ettenger, C. M. E., Southern Ry., Washington, D. C.

2. Mechanical Stokers: A. Kearney (Chairman), A. S. M. P., N. & W. Ry., Roanoke, Va.; M. A. Kinney, S. M. P., Hocking Valley R. R., Columbus, Ohio; J. R. Gould, S. M. P., C. & O. Ry., Richmond, Va.; J. T. Carroll, A. G. S. M. P., Balto. & Ohio R. R., Baltimore, Md.; J. W. Cyr, S. M. P., C. B. & Q. Ry., Chicago, Ill.; A. J. Fries, A. S. M. P., N. Y. Central Lines, Depew, N. Y.; G. E. Sisco, A. E. M. P., Penna. Lines, Columbus, Ohio.

3. Fuel Economy and Smoke Prevention: Wm. Schlafge (Chairman), G. M. S., Erie R. R., New York City; W. H. Flynn, S. M. P., Mich. Central R. R., Detroit, Mich.; D. M. Perine, S. M. P., Penna. R. R., New York City; Robert Quayle, G. S. M. P. & C., C. & N. W. Ry., Chicago, Ill.; S. G. Thomson, S. M. P. & R. E., Phila. & Reading Ry., Reading, Pa.; D. J. Redding, A. S. M. P., P. & L. E. R. R., McKee's Rocks, Pa.; W. J. Tollerton, G. M. S., C. R. I. & P. Ry., Chicago, Ill.

Special Committees.

4. Design and Maintenance of Locomotive Boilers: C. E. Fuller (Chairman), S. M. P., Union Pacific R. R., Omaha, Neb.; A. W. Gibbs, C. M. E., Penna. R. R., Philadelphia, Pa.; D. R. MacBain, S. M. P., New York Central R. R., Cleveland, Ohio; M. K. Barnum, G. M. I., Balto. & Ohio R. R., Baltimore, Md.; R. E. Smith, G. S. M. P., Atlantic Coast Line R. R., Wilmington, N. C.; C. B. Young, M. E., C. B. & Q. R. R., Chicago, Ill.; J. Snowden Bell, New York City.

5. Locomotive Headlights: D. F. Crawford (Chairman), G. S. M. P., Penna. Lines, Pittsburgh, Pa.; C. H. Rae, G. M. M., L. & N. R. R., Louisville, Ky.; F. A. Torrey, G. S. M. P., C. B. & Q. R. R., Chicago, Ill.; H. T. Bentley, S. M. P. & M., C. & N. W. Ry., Chicago, Ill.; M. K. Barnum, S. M. P., Balto. & Ohio R. R., Baltimore, Md.; Henry Bartlett, G. M. S., B. & M. R. R., Boston, Mass.; W. H. Flynn, S. M. P., Mich. Central R. R., Detroit, Mich.; W. O. Moody, M. E., Illinois Central R. R., Chicago, Ill.

6. Superheater Locomotives: W. J. Tollerton (Chairman), G. M. S., C. R. I. & P. Ry., Chicago, Ill.; H. W. Coddington, Engr. Tests, N. & W. Ry., Roanoke, Va.; C. H. Hogan, A. S. M. P., N. Y. C. & H. R. R. R., Albany, N. Y.; R. W. Bell, G. S. M. P., Ill. Cent. R. R., Chicago, Ill.; T. Roope, S. M. P., C. B. & Q. R. R., Lincoln, Neb.; W. C. A. Henry, S. M. P., Penna. Lines, Columbus, Ohio; E. W. Pratt, A. S. M. P., C. & N. W. Ry., Chicago, Ill.; G. M. Basford, 30 Church street, New York City.

7. Equalization of Long Locomotives: S. G. Thomson (Chairman), S. M. P. & R. E., Phila. & Reading Ry., Reading, Pa.; S. M. Vauclain, Baldwin Locomotive Works, Philadelphia, Pa.; F. J. Cole, American Locomotive Works, Schenectady, N. Y.; O. C. Cromwell, M. E., B. & O. R. R., Baltimore, Md.; Wm. Elmer, S. M. P., Penna. R. R., Buffalo, N. Y.; J. F. Enright, S. M. P., D. & R. G. R. R., Denver, Colo.; C. H. Rae, G. M. M., L. & N. R. R., Louisville, Ky.

8. Dimensions of Flange and Screw Couplings for Injectors: M. H. Haig (Chairman), M. E., A. T. & S. F. Ry., Topeka, Kan.; T. F. Barton, M. M., D. L. & W. R. R., Kingsland, N. J.; W. W. Winterrowd, M. E., Can. Pac. Ry., Montreal; B. F. Kuhn, A. M. M., N. Y. C. R. R., Collinwood, Ohio; S. B. Andrews, M. E., S. A. L. Ry., Portsmouth, Va.; M. D. Franey, M. M., N. Y. C. R. R., Elkhart, Ind.; J. C. Mengel, M. M., Penna. R. R., Altoona, Pa.

9. Design, Maintenance and Operation of Electric Rolling Stock: C. H. Quereau (Chairman), New York Central R. R., New York City; G. C. Bishop, S. M. P., Long Island R. R., Richmond Hill, L. I., New York City; G. W. Wildin, M. S., N. Y., N. H. & H. R. R., New Haven, Conn.; J. H. Davis, E. E., B. & O. R. R., Baltimore, Md.; R. D. Hawkins, S. M. P., Great Northern Ry., St. Paul, Minn.; J.

F. DeVoy, A. S. M. P., C. M. & St. P. Ry., W. Milwaukee, Wis.; T. W. Heintzelman, G. S. M. P., Southern Pacific Co., San Francisco, Cal.

10. Best Design and Materials for Pistons, Valves, Rings and Bushings: H. T. Bentley (Chairman), S. M. P., C. & N. W. Ry., Chicago, Ill.; C. F. Giles, S. M., L. & N. R. R., Louisville, Ky.; A. K. Gallaway, M. M., B. & O. R. R., Baltimore, Md.; L. A. Richardson, M. S., C. R. I. & P. Ry., Des Moines, Iowa; G. W. Rink, M. E., C. R. R. of N. J., Jersey City, N. J.; W. D. Robb, S. M. P., G. T. Ry., Montreal, Can.; Joseph Chidley, A. S. M. P., N. Y. C. R. R., Cleveland, Ohio.

11. Co-operation with Other Railway Mechanical Organizations: John Purcell (Chairman), Asst. to Vice-Prest., A. T. & S. F. Ry., Chicago, Ill.: W. C. Hayes, S. L. O., Erie R. R., New York City; F. C. Pickard, M. M., D. L. & W. R. R., Buffalo, N. Y.: F. O. Bunnell, Engr. Tests, C. R. I. & P. Ry., Chicago, Ill.; W. P. Carroll, M. M., N. Y. C. R. R., Rochester, N. Y.; E. S. Fitzsimmons, M. S., Erie R. R., New York City; J. H. Davis, E. E., B. & O. R. R., Baltimore, Md.

12. Powdered Fuel: C. H. Hogan (Chairman), A. S. M. P., N. Y. C. R. R., Albany, N. Y.; E. W. Pratt, A. S. M. P., C. & N. W. Ry., Chicago, Ill.; Thos. Roope, S. M. P., C. B. & Q. R. R., Lincoln, Neb.; J. H. Manning, S. M. P., D. & H. Co., Watervliet, N. Y.; Charles James, M. S., Erie R. R., Cleveland, Ohio; W. H. V. Rosing, S. E., St. L. & S. F. Ry., Springfield, Mo.; G. L. Fowler, 83 Fulton street, New York City.

13. Forging Specifications: C. D. Young (Chairman), Engr. Tests, Penna. R. R., Altoona, Pa.; J. R. Onderdonk, Engr. Tests, B. & O. R. R., Baltimore, Md.: A. H. Fetters, M. E., Union Pacific Ry., Omaha, Neb.; Frank Zeleny, Engr. Tests, C. B. & Q. R. R., Chicago, Ill.; H. E. [illegible] Tests, A. T. & S. F. Ry., Chicago, Ill.; Prof. L. S. Randolph, Virginia Poly- [illegible]

14. Train Resistance and Tonnage Rating: P. F. Smith, Jr. (Chairman), [illegible] W. E. Dunham, Supt. M. P. & M., C. & N. W. Ry., Winona, Minn.; H. C. Manchester, S. M. P., D. L. & W. R. R., Scranton, Pa.; C. E. Chambers, S. M. P., C. R. R. of N. J., Jersey City, N. J.; [illegible] L. B. Jones, A. E. M. P., Penna. Lines, [illegible] University of Illinois, Urbana, Ill.

15. Modernizing of Existing Locomotives: F. J. Cole (Chairman), American Loco. Co., Schenectady, N. Y.; J. C. Little, M. E., C. & N. W. Ry., Chicago, Ill.; C. A. Gill, G. M. M., B. & O. R. R., Baltimore, Md.; M. J. Drury, S. S., A. T. & S. F. Ry., Topeka, Kan.; R. D. Hawkins, S. M. P., G. N. Ry., St. Paul, Minn.; D. J. Mullen, S. M. P., C. C. C. & St. L. Ry., Indianapolis, Ind.; J. Snowden Bell, New York City.

16. Subjects: A. W. Gibbs, C. M. E., Penna. R. R., Philadelphia, Pa.; D. R. MacBain, S. M. P., L. S. & M. S. Ry., Cleveland, Ohio; C. E. Fuller, S. M. P., Union Pacific R. R., Omaha, Neb.

17. Arrangements: E. W. Pratt, A. S. M. P., C. & N. W. Ry., Chicago, Ill.; D. R. MacBain, S. M. P., N. Y. C. R. R., Cleveland, Ohio; O. F. Ostby, 80 Broadway, New York City.

Erie Railroad Celebration.

The following letter which explains itself was recently received from Mr. W. F. Hooker, assistant to President Underwood of the Erie Railroad:

Eighty years ago the first shovelful of dirt for the construction of the dear old Erie was turned at Deposit, N. Y., and in order that the anniversary be properly celebrated the Business Men's Association of Deposit, with the assistance of this company, has arranged an interesting program, including a civic parade, speeches, etc. They want to make the dirt fly again, and have asked us to invite you and others of the Erie official family to be present. Therefore you are here and now formally invited.

We will leave Jersey City on a special train at 9:00 A. M., November 6, arriving at Deposit at about 1:30 P. M. The parade will start from the Erie station when we arrive. The Depositites will meet us with automobiles, and we will lead a procession consisting of a brass band, several lodges, the fire department, school children, and I suspect the Suffragists and the Antis. Our train will leave Deposit for Jersey City at the convenience of the party.

Please let me know soon as possible if you will be one of our party. It is the desire of the official family that there be a good representation of Erie people as this is an event of importance in the history of the company.

Mr. W. H. Lewis to Dr. Sinclair.

Mr. William H. Lewis, superintendent [illegible] of the Norfolk & Western Railway, is an old time friend of Dr. Angus Sinclair. On Mr. Lewis reaching [illegible] Dr. Sinclair, [illegible] ment:

"I cannot express to you how much I appreciate your kind remembrance and congratulations on my reaching the allotted span of life. It is indeed a great pleasure to feel that we enjoy the friendship and good will of one that has con- [illegible] exemplary character has set an example of a high moral standard that will prove an inspiration to young men who are growing up to take our places in the activity and progress of our calling."

A New Classification.

A Columbus, Ohio, banker once gave his wife a book of blank checks, all properly signed and ready for filling in.

"You are welcome to use these as you see fit," he told her, "but I want you to write on the stub of each just what that check was used for, then when the book has been used up I will look over the stubs and see what disposition you made of them."

She handed him the book the other day, after using all the checks, and he began an inspection of the memoranda on the stubs.

"Here is check seventy-nine for $75, marked 'church expenses.' What church expenses are these? I have regularly paid the assessments," he said.

"Oh," replied the wife, "that was for a new Easter bonnet."

Her Economy.

"Woman is very unreasonable," said a venerable New Hampshire justice of the peace. "I remember that my wife and I were talking over our affairs one day, and we agreed that it had come to the point where we must both economize.

"'Yes, my dear,' I said to my wife, 'we must both economize, both!'

"'Very well, Henry,' she said, with a tired air of submission, 'you shave yourself, and I'll cut your hair.'"

Narrow Escape.

Two Irishmen, bent on robbery, held up a passing Scotchman. After a long, fierce fight, in which the Scotchman had almost had the better of it, they succeeded in conquering him. A thorough search of his clothes discovered one lone sixpenny piece. "Troth, Pat," said Mike disgustedly, "if he'd had a bob instead of a tanner he'd have murdered the two of us."

The Same Day.

"Remember, darling, this is Sunday and you must not play in the front yard," admonished a little girl's mother.

"Well, mamma," she asked thoughtfully, "isn't it Sunday in the back yard, too?"

The Real Thing.

"You say your husband was cut by his neighbors at the party?"

"Yassah, dat's so, sah."

"Did they cut him with malice prepense?"

"No, sah; wiv a razah, sah."

"It's all in the flakes"

Easy Spreadin' Paint

is mostly of th' easy wearin' kind — like some graphite paints I know without no backbones to 'em. It's the silica that puts the fight in graphite an' that's why th' shops been usin'

DIXON'S
Silica-Graphite
PAINT

for th' last fifty years. Silica and graphite make an ideal combination of inert pigments —Nature's own mixture from the Dixon Mines at Ticonderoga, N. Y. Dixon's Paint means easy work for th' boys, less brush wear for th' boss an' an everlastin' good job for the owners of bridges, boiler fronts, smokestacks, iron fences an' all other metal surfaces.

Write for booklet No. 69-B.

Made in Jersey City, N. J., by the

Joseph Dixon Crucible Company

DIXON TRADE MARK Established 1827 DIXON TRADE MARK

B-38

RAILROAD NOTES.

The Boston & Maine [illegible] for 25,000 [illegible].

The Norfolk & Western is in the market for 1,000 90-ton gondola cars.

The Pennsylvania Railroad, according to report, will enter the market for 10,000 cars.

The Chicago & North Western has ordered 15,000 tons of rails from the Illinois Steel Company.

The New York, Chicago & St. Louis has ordered 2,500 tons of rails from the Carnegie Steel Company.

The Jamestown Railway has ordered 550 tons of structural steel from the Empire Structural Steel Company.

The Campbell's Creek Coal Company has ordered 100 gondola cars from the American Car & Foundry Company.

A report says that the Russian government may enter the market for 150 locomotives in addition to previous orders for 400.

The Emlenton Refining Company, Emlenton, Pa., has ordered 100 gondola cars from the American Car & Foundry Company.

The Nashville, Chattanooga & St. Louis has ordered 8,000 tons of rails from the Tennessee Coal, Iron & Railroad Company.

The Central of Georgia has ordered 8 Mikado type locomotives and 4 Pacific type locomotives from the Lima Locomotive Corporation.

The Illinois Central has ordered 1,000 tons of steel from the American Bridge Company for a car repair shop at Nonconnah, Tenn.

The Erie has let contracts for 33 locomotives. This company has also been getting prices on 300 hopper bottom gondolas.

The Buffalo, Rochester & Pittsburgh has let contracts for 10 locomotives, and has ordered 900 steel underframes for freight cars.

The Michigan Central has ordered 7 Pacific type locomotives from the American Locomotive Company and is inquiring for 6 Mikado type locomotives.

The Seaboard Air Line has let contracts for a large [illegible] the company's shops at Portsmouth, Va., and Jacksonville, Fla.

The Southern has ordered 10,000 tons of rails from the Tennessee Coal, Iron & Railroad Company, and 2,000 tons from the Pennsylvania Steel Company.

The Tennessee, Alabama & Georgia is reported as having plans prepared for the construction of a roundhouse and other buildings at Gadsden, Ala.

The Illinois Central has ordered 47 Mikado type locomotives from the Lima Locomotive Corporation and 3 Santa Fe type locomotives from the American Locomotive Company.

The Wheeling & Lake Erie has ordered 750 gondola cars from the Standard Steel Car Company, and 200 steel automobile cars from the Western Steel Car & Foundry Company.

Newspapers report that Russia is about to close contracts for 10,000 cars. These are probably the light 4-wheel cars which have been under negotiations for some time.

The Lehigh Valley has ordered 10 Mikado type locomotives from the Baldwin Locomotive Works, and has given the latter an order to repair 20 other engines and equip them with superheaters.

The Baltimore & Ohio has divided an order for 62,500 tons of rails among the Maryland Steel Company, the Cambria Steel Company, the Carnegie Steel Company and the Illinois Steel Company.

The Wabash will install superheaters on 45 Mikado type locomotives at its Decatur, Ill., shops. It is now completing the installation of superheaters on 18 engines, thus making 63 altogether.

The Michigan Central has ordered 500 all-steel automobile cars from the Haskell & Barker Car Company. These are in addition to 500 cars ordered from the same company several weeks ago.

The Sioux City Terminal has ordered one six-wheel switching locomotive from the American Locomotive Company. This locomotive will have 19 by 24-in. cylinders and a total weight in working order of 117,000 pounds.

The International & Great Northern, which plans to build new shops and roundhouse just south of San Antonio, Texas, is reported as making preparations to begin construction at an early date.

The Chicago & North Western has let

contracts for 12 Pacific type engines, 12 Mikados and 1 Mogul for its own use, and 4 Pacific type engines and 6 Mikados for the Omaha system, making 35 in all.

The New Orleans & North Eastern has ordered 4 Mikado type locomotives from the Baldwin Locomotive Works to be used on the Vicksburg, Shreveport & Pacific. These locomotives will have 22 by 28 in. cylinders.

The New York, New Haven & Hartford has ordered 10,000 tons of rails from the Pennsylvania Steel Company. About the same quantity was divided between the Lackawanna Steel Company and Bethlehem Steel Company.

The Chicago Junction has ordered two superheater six-wheel switching locomotives from the American Locomotive Company. These locomotives will have 20 by 26 in. cylinders, 51 in. driving wheels, a total weight in working order of 149,000 pounds, and a steam pressure of 180 pounds.

The Dominion Railway Department has placed orders for rolling stock aggregating $1,250,000 for Government railways. The Canadian Locomotive Works, Kingston, is to supply 15 locomotives, while an order for 1,000 box cars is divided between the Canada Steel Car & Foundry Company, Montreal; the National Car Company, Hamilton, and the Eastern Car Company, Halifax.

Water Grates Were Used in Pompeii.

[illegible] inven- [illegible] water grates for hard coal burning locomotives. As far as we have been able to find out there have been about fifty patents granted for water grates to be used on hard coal burning locomotives, and reported to be new and original inventions.

To those who think that to ingenious friends belongs the original idea of water grates, we would recommend the study of inventions relating to boilers brought into use long, long ago.

In Naples, Italy, there is a museum where a great collection of articles found in Pompeii are carefully preserved. Among many devices that have been reinvented in times within the memory of men still living, is a small vertical boiler of copper which has a fire box at the base and a smoke flue through the top. There is a door on the side and it has water grates composed of small copper tubes where the fuel rested.

Pompeii was destroyed A. D. 79 by an eruption of Mount Vesuvius, so there must have been ingenious inventors and skilled mechanics during the infancy of [illegible]

The Observing Habit.

Keen habits of observation nearly always promote success. A conspicuous weakness in our systems of education is that the memory is habitually developed and habits of observation neglected.

Sir James M. Barrie relates an instance of the late Prof. Chrystal's readiness in applied mathematics. One day, when he was producing on the blackboard those "spiders' webs in chalk" which were the despair of the unlearned, a student near the top of the room dropped a marble, which bumped down step by step, to the level of the rostrum. Chrystal, unheeding the giggles of the class, went on with his work. When the marble came to rest he observed, "Will the student at the end of Bench 41 kindly stand up?" He had counted the bumps made by the marble in its descent.

A Ladder Former.

Nearly all blacksmith shops that do railway work are well provided with labor saving devices, but we occasionally come across cases where the ingenuity of one man produces labor saving devices that save the work from suspension. A car building contract shop received an order for cars that had to be equipped with ladders of a most complex pattern, four ladders to the car, the idea of an intricate designer. When the shop began turning out eighteen cars a day, twenty-five men were kept busy making the ladders. Shortly after the work was started, the foreman, who always encouraged the men to devise labor saving appliances, was shown a device made by one of the workmen which was a ladder former. When put into service the former enabled one blacksmith to make all the ladders needed.

Try Farming.

A very common recommendation made by political economists is for more ambitious young men dependent upon their own industry for success in life is to turn farmer, and the answer generally heard is that all the land worth cultivating has been taken up. That is far from being true for a recent government report says that the State of Nevada has 55,417,746 acres of unoccupied public land; Michigan has 76,030 acres, subject to entry; Kansas 75,214, North Dakota 493,667, South Dakota 2,880,828, Alabama 47,940, Arizona 36,810,327, Arkansas 278,133, California, 20,635,923, Colorado 17,236,114, Florida 268,484, Idaho 16,212,273, Louisiana 101,016, Minnesota 943,831, Mississippi 36,882, Montana 19,065,121, Nebraska, 192,358, New Mexico 27,788,357, Oklahoma 42,177, Oregon 15,442,178, Utah 33,363,837, Washington 1,144,605, Wisconsin 6,758, Wyoming 30,929,969.

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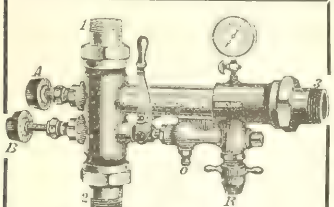

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Books, Bulletins, Catalogues, Etc.

Practical Mechanics and Applied Subjects.

[illegible] the above subject, by Prof. Joseph W. L. Hale, of the Pennsylvania State College. The work is the result of several years' [illegible] velopment of a system of railroad apprentice schools, as well as other extensive systems of investigation in vocational and corporation schools. The scope of the work is sufficiently broad to apply to railroad schools, particularly as well as other mechanical trades generally, and is divided into twenty chapters, each dealing with a definite subject. Machine shop practice is very fully and clearly described. The chapter on electricity is particularly lucid, and the question and answer method adopted makes the subject easy of comprehension. The chapter on the strength of materials is also a mastery of condensation on an important subject, and the book altogether fits its purpose admirably. The book contains 228 pages of letterpress and drawings, and is substantially bound. Price one dollar.

Statistics of Railways.

[illegible] Washington, D. C., has published its annual report, which is based upon official data published by the Interstate Commerce Commission. Prior to 1911 the Commission presented the statistics of railways by ten territorial groups. Beginning with 1911 it has presented the statistics in three districts representing the three important traffic areas. The statistics of population, area, mileage, capital, number of employees, are taken partly from the Census Bureau, and partly from the Interstate Commerce Commission reports, the whole forming a very convenient reference regarding the various aspects of railway operations in the United States. Copies may be had from Mr. Julius Parmalee, statistician, Washington, D. C.

Staybolts.

The Monthly Digest, issued by the Flannery Bolt Company, Pittsburgh, Pa., gain in interest from month to month, as the use of the Tate Flexible Staybolt increases with the years, and the tendency [illegible] to cover greater sheet areas, where formerly small installations were made for trial tests. The decrease in firebox maintenance has brought this about when data is kept showing the results when about 200 Tate staybolts were used in a boiler, where over 500 are being used at the present time. On some of the larger railroad systems at least 400 locomotives [illegible] Bolt are now in service and the number is being constantly increased. A perusal of one of the company's bulletins will convince anyone of the valuable service of the device as an article of economic and practical utility. No. 4 Bulletin, recently issued, presents an interesting report from a Committee of the Master Boiler Makers' Association, copies of which may be had from the company, or from Mr. Harry D. Vought, 95 Liberty street, New York.

Reactions.

The Goldschmidt Thermit Company, 90 West street, New York, issue their periodical *Reactions* four times a year. The latest is of particular interest to railroad men, conveying as it does comparisons between thermit and electric welding, descriptions of the use of thermit in machine shops, with numerous instances of repairs where thermit should have been used in the first place. This seems particularly true in the case of locomotive frame welding, and indeed, if thermit had been put to no other use than in this important branch of locomotive breakages, it has paid its way a thousand times. In smaller breakages, like connecting rods, they are taken in bunches in the larger shops and two or three of them welded at once. Where crossheads break entirely through, it would never have occurred to anyone to think of repairing them in the old days. With the use of thermit the crosshead is in operation in one day, and so on; but we cannot even begin to give a brief notice of all the amazing operations that are being successfully carried on. Skill that comes from experience is an important factor in all this, as is particularly shown in frame welds without dropping the wheels. All interested should send for a copy of the latest issue of *Reactions* which may be had free from [illegible] City.

North Pacific Ports.

The Pacific Shipping Year Book, published by the Terminal Publishing Company, Seattle, Wash., at two dollars annually is already on sale at all first-class booksellers. The book is the only complete authority on all facts relative to the facilities at all ports, charges on shipping, and the many miscellaneous items of daily and hourly use to the shipper, importers, agents and others having any business in Alaska, British Columbia, [illegible]

Graphite

[illegible] this [illegible] Company, Jersey City, that, in addition to the steadily growing home demand, the foreign countries seem to eat up graphite. It would be difficult indeed to follow the wonderful lubricant into all its mercurial channels, but when it is generally admitted that all bearings and gearings, whether transmission or differential, run 100 per cent. better with Dixon's lubricants than with any other, and there is less noise, and no dripping of oil, it can be readily imagined that where it is once introduced it grows in favor. Not only so, but in many other ways it is paramount [illegible] should be in use wherever pipe is jointed. The joint is tighter and the joint comes apart when necessary with an ease that is surprising. Then in its variety of effects it only needs to be observed to be appreciated. It prevents boiler scale. It prevents the weather from affecting paint —but send for a copy of *Graphite* and read the testimony of men of the widest experience. Address the company at Jersey City, N. J.

Locomotive Charts.

[illegible] 3 Amen Corner, London, England, has just issued two locomotive charts, a [illegible] wheeled. The charts measure 24 by 18 inches. The parts are numbered and named. The drawings are excellent. Both represent the most powerful types of British constructed locomotives built for the Mashonaland Railway. Both are equipped with brick arches and super- [illegible] and the locomotives altogether are the [illegible] motives of their kind that we have had [illegible] proof that the British colonies have a strong preference for the American types of locomotives with outside cylinders and [illegible] twenty-five cents each.

Locomotive Engine Running and Management.

[illegible]

Engine Running and Management," has [illegible]

ments in the art, which bring it fully up to date.

Dr. Angus Sinclair spent the early years of his life as a locomotive fireman and engineer, and has been for many years considered one of the best authorities on the economical use of fuel in locomotives. He needs no introduction to the members of the Fuel Association, the Traveling Engineers' Association, and the various other associations of railroad mechanical men, as his familiar face is generally seen at all their conventions, and he has for many years been treasurer of the American Railway Master Mechanics' Association.

While Dr. Sinclair's book treats in a general way of the design of different classes of locomotives and describes in a general way the construction and use of the different parts of the locomotive, yet it does not aim to go into minute details, but gives particular attention to the inspection of the locomotive, its preparation for the road and its operation in handling various kinds of trains.

In the new edition, some of the more important chapters are Steam and Motive Power, Design and Operation of Locomotives, Engineers and their Duties, Running a Fast Train, Getting Up the Hill, Sight Feed Lubricators, Boiler Feed Appliances, Valve Motion, Modern Air Brake Equipment, Tractive Power and Train Resistance, Cumbustion, Draft Appliances, etc.

We find that some of the most important additions to this edition, which are not included in the original, are chapters on the Mallet Articulated Compound Locomotive and the one on Superheated Locomotives.

On account of the simple and thorough manner in which this book treats the subject, it is a most valuable source of information, which every man who desires to advance in either shop practice or locomotive operation, should own and study. It will also be found very interesting and useful to anyone employed in the operating department, who desires to be fully informed on railroad matters.

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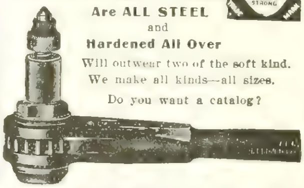

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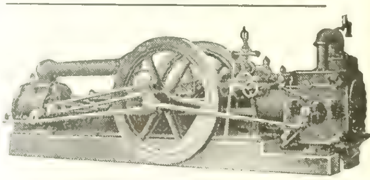

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Railway and Locomotive Engineering

A Practical Journal of Motive Power, Rolling Stock and Appliances

Vol. XXVIII. 114 Liberty Street, New York, December, 1915. No. 11

Completion of the Great Tunkhannock Viaduct on the New Cut-off on the Delaware, Lackawanna & Western Railroad

VIEW OF TUNKHANNOCK CUT-OFF AND [illegible]

The stupendous projects in railroad construction, which have been completed recently in the East, not only outrivals the engineering feats in the West, but surpass anything hitherto attempted in the world. At the first glance these works seem to be out of proportion to the gain made, but engineering skill projects its mind into the far future, and it may be relied upon that all of these great feats in engineering will eventually redound to the enterprise of the projectors.

In the latest great work on the Delaware, Lackawanna & Western Railroad, the distance between New York and Buffalo is shortened less than four miles, but in gaining that short distance difficulties have been overcome that are in their solution greater than many complete railroads. The Tunkhannock Viaduct, spanning a deep valley and passing the great highway from mountain to mountain, is the largest structure of its kind in the world. It was formally opened to traffic last month, completing the last link in the cut-off between Clark's Summit and Hallstead, Pa.

The most important [illegible] the great viaduct shown in our frontispiece illustration, is 2,375 feet in length, 240 feet in height, and composed of ten 180-foot and two 100-foot spans. It reduces a maximum grade of 1.23 per cent to .68 per cent., and a former curvature of 3.970 degrees to 1.570 degrees. It contains 4,509,000 cubic feet of concrete, and 2,280,000 pounds of reinforcing steel.

Another viaduct which receives little attention only because it is dwarfed by the Tunkhannock project is the Martin's Creek Viaduct about nine miles west of the first bridge. Being 1,600 feet long, and composed of eleven spans, seven of 150 feet, two of 100 feet and two of 50 feet, it is the largest concrete bridge in the world, excepting only Tunkhannock.

These tremendous viaducts are but two links in the forty-mile chain, which includes vast excavations and huge mounds constructed to plane the eccentricities of nature down to the level required by twentieth century railroading. A double track tunnel 3,630 feet long, only 600 feet shorter than the Bergen Hill Tunnel,

[illegible] engineers [illegible] still another variety. This tunnel, which has two 135-foot ventilating shafts lined with concrete, necessitated excavating 3,000,000 cubic yards of earth. The work on the entire cut-off, from the date the first steam shovel was put into motion, June, 1912, to completion, required the removal of 13,000,000 cubic yards of dirt and rock.

It is what railroad men know as a replacement line, being for the most part in sight of the old line for which it is substituted. The radical reduction of grades and curves is achieved by very heavy cutting and filling, and by viaducts of enormous size, all of which was impossible in the early days of railroading. Some idea of the magnitude of the operation is seen from the fact that the amount of earth moved reached a total of 5,525,000 cubic yards, while the rock excavation amounted to 7,647,000 cubic yards. 8,100,000 cubic feet of concrete were used, and the amount of re-enforcing steel employed in the various bridges, viaducts and culverts amounted to 4,720,000 pounds.

For almost its entire length the route presented difficult engineering problems, and few stretches of tracks were laid without the necessity of overcoming some obstacle. The new work begins near Clark's Summit Station, the new line crossing the old twice at a grade which is 29 feet below the old at the Station. The cut at this point is about two miles [illegible] the north end of this cut the new line [illegible] miles near Factoryville, and then re[illegible] Nicholson. The new line between [illegible]

grace in outline. Among these the Slayton, shown in the illustration, is a fine example, with its reinforced floor and concrete supporting arch. The artistic, graceful lines of these structures, typical of the many concrete bridges, arches and viaducts along the cut-off, plainly indicate that beauty as well as permanency and utility is a factor in modern railroad construction. The station at La Plume is constructed of field stone and its red tile roof affords a particularly effective contrast with the green of the surrounding landscape. Next follows an equally artistic station at Factoryville, built of concrete with a brick veneer up to the windows.

The south branch of Tunkhannock Creek which the traveler now approaches is reached by an enbankment 140 feet high, requiring 1,600,000 cubic yards of material. This embankment is over 2,000 feet in length and from its summit may be obtained a wonderful panoramic view of the surrounding country with [illegible] mountains visible in the distance.

The divide between the north and south branches of this creek is passed in a double track tunnel 3,630 feet long with approach cuts aggregating 27,000,000 cubic feet of excavation. This tunnel, the only one on the cut-off, is 600 feet shorter than the Bergen Hill Tunnel. It has two 135-foot ventilating shafts lined with concrete, while the rest of the tunnel is lined with brick.

The entire work of building this great [illegible] chief engineer of construction in imme[illegible] hannock Viaduct was built under the [illegible]

Development of Rapid Transit

[illegible] ing public have derived from the use of railroads. The railroad fare today from New York to Philadelphia is $2.25; in 1830 the stage coaches formed the most rapid means of travel, the fare was ten dollars. The journey is now made in two hours; in the good old times when the romance of coaching was in its glory, the trip took twelve hours in good weather, in bad weather uncertain.

In his diary George Washington tells of riding on horseback from Philadelphia to Boston in one week and expresses the belief that he was going some. The distance is about 300 miles, so the Father of his Country managed to push his horse 50 miles every traveling day, which, of course, would not include Sunday. A traveler leaving Boston in a hurry might, if he managed to make easy connection, go to Philadelphia in about seven hours.

The change represented by this increase of easy and rapid transit has done more to promote true civilization than any other influence.

SLAYTON BOWSTRING ARCH, TYPE OF OVERHEAD HIGHWAY BRIDGES ON THE NEW LACKAWANNA CUT-OFF.

Railways in India.

There are about 35,000 miles of railway operated in British India. The population is very dense and there is considerable railway passenger traveling and fair freight business, but the rates are so low that it is a mystery to us how the companies can pay operating expenses, but wages are miserably low.

The average rate charged to passengers of all classes was 2.47 pies (just over two-fifths of 1 cent) per mile, and the average distance traveled was about 38 miles.

The total number in railway employ at the close of the year was 563,030, of whom 7,699 were Europeans, 9,877 Anglo-Indians, and 545,454 Indians. The average rate for all descriptions of freight carried was 4.73 pies per ton-mile, or just under 1 cent.

The total number of passengers carried was 389,860,000, as compared with 371,580,000 in the previous year, giving an increase of $4,446,000 in earnings from this source.

Another Canadian Transcontinental Line.

With the arrival last month of the first through train over the Canadian Northern Railway at Vancouver, B. C., another Canadian transcontinental railway connected the Atlantic with the Pacific, making three all-Canadian lines in operation, and making possible the rapid growth and development of British Columbia. The company has now over 10,000 miles of railroad in operation, and is second only to the Canadian Pacific, which has a mileage of over 11,000.

The vast territory opened up by the new railroad surpasses in extent the half [illegible]

Continued Improvements on the Baltimore and Ohio.

Enlarged terminal facilities will soon be placed in operation by the Baltimore and Ohio Railroad in Chicago, with the completion of the new coach yard, engine house, concrete storehouse and other buildings at Robey street, which will take the place of the terminal at Empire Slip. The improvements, which will afford the company more spacious quarters as well as terminals of latest design, were necessitated by the new Union Station plans of the Pennsylvania and the Chicago, Burlington and Quincy railroads in Chicago.

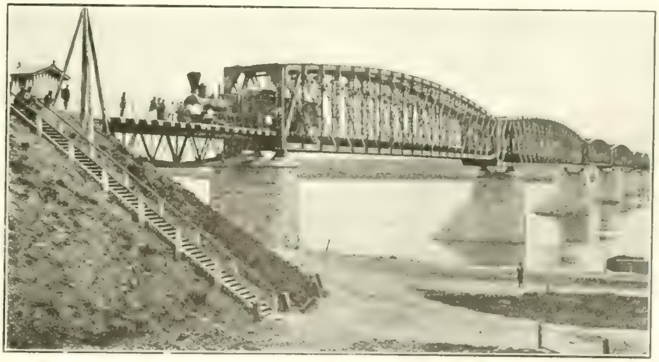
The engine house site and its department facilities, which include the turntable, engine washing platform, ash pit, coaling station and sand house, occupies an area of 8.4 acres. These facilities are all being constructed on practically the same level as the Baltimore and Ohio's elevated tracks. The coaling station will have a storage capacity of 1,000 tons divided into seven compartments. The engine house has 33 stalls, each approximately 100 feet long. Three of the stalls will be provided with engine driver and pony truck drop pits. The smoke from the locomotives in the engine house will be conveyed through a duct to a tall stack. In this smoke duct between the engine house and the stack, provision will be made for a future smoke washer or precipitator. A small machine shop, blacksmith shop, toilet and locker rooms will be constructed in connection with the engine house.

Thames River Bridge.

The New York, New Haven & Hartford Railroad Company are completing arrangements for the building of a new bridge over the Thames river at New London. The present bridge, built in 1888, although originally a two-track structure, owing to the increased weight of equipment, has been limited to single track operation. The new bridge will be constructed to carry the heaviest loading now known or contemplated. There will be a four-track structure, with a two-track superstructure, leaving room for two more tracks later on. It will be a fine span structure with bascule type of lift. It will be erected 185 feet further up the stream than the present bridge. When the new bridge is finished the old bridge will be given to the State of Connecticut for use as a highway bridge. The old bridge cost $1,300,000. The new bridge will cost about twice as much. The bridge will measure about 1,400 feet in length, and the approaches to the bridge will be 1,300 feet on the west side, and 1,600 feet on the east side. The abutments will be of reinforced concrete, and about 5,000 tons of steel will be used in its construction.

Russia's Eastern Gateway.

The accompanying illustration is a view of a bridge that spans the great Ob fluvial way in Central Siberia. There are seven spans each of 350 feet in length, and it is the third largest bridge in Asia, being only surpassed by what are known as the Enecci and the Amur bridges, the latter located in Eastern Siberia and over two miles in length. The bridge shown is almost a duplicate of another bridge in the same road that spans the Tom River. The bridges are nearly all being enlarged over the entire trans-Siberian route. With the winter closing in of the European part of Archangel, the trans-Siberian railway is the only outside source of supply for munitions and other products. The supplies from America are now going forward in an almost continuous stream over the 5,000-mile road from Vladivostock in Eastern Siberia to the battle front in Western Russia. The railroad is serving Russia in good stead in a way that it was never designed to do, and in a manner that was never thought of before the present war. While the building of the railway was primarily a military necessity in order to get supplies to the Far East, it was not expected that a necessity might arise for it being used to bring supplies from the East.



TYPE OF BRIDGE ON THE TRANS-SIBERIAN RAILWAY

So it is that the trans-Siberian railroad is now proving to be Russia's chief hope of safety in a double sense, as munitions and food supplies chiefly from America and Japan fill every train night and day and apparently will continue to do until other channels of admission are opened up. It is also a means of developing Russia along the great undeveloped areas of the country. The Tomsk University, situated in Central Siberia, is on the line of the great railway, and in the engineering classes there are over 3,000 students, some of whom recently visited America in order to become familiar with the latest improvements in the mechanical appliances used on railways. It will be recalled that in the days of the American Civil War, much of the [illegible] supplies came from Russia, so that, commercially speaking, we are merely carrying out the idea of international reciprocity to which this trans-Siberian road so favorably lends itself.

Industrial Accidents.

It is almost beyond belief that among industrial accidents over ten per cent. are owing directly, or indirectly, to the lack of proper illumination. This is the more to be regretted that as the means of lighting is now so cheap that it is in every sense cheaper than damages. Safety first should include statistics bearing upon this as well as kindred subjects, as the lack of statistics is very often misleading. In this regard there is nothing more common than to place the great bulk of railway accidents involving life and limb than to place the primary cause on the fault of those who are classed as tramp trespassers, whereas recent investigations made by Mr. Marcus Dow, of the New York Central Lines shows that the trespassers, so-called, do not consist of unemployed tramps using the railroads because of the lack of other roads, but people who are employed near the railroads and who carelessly attempt to use the railroads at congested points.

Aluminum.

The consumption of aluminum is constantly expanding. It is the most abundant of metals and ranks third among the elements which compose the crust of the earth, being exceeded only by oxygen and silicon. According to the U. S. Geological Survey, the quantity of aluminum consumed in the United States in 1914 [illegible] pounds in 1913 and 65,607,000 pounds in 1912. The growth of the industry is shown by the fact that the production [illegible] in 1894, and 8,000,000 pounds in 1904.

Eightieth Anniversary of the Erie Railroad

Enthusiastic Celebration By the Business Men's Association of Deposit, N. Y. and Erie Officials and Employees

One of the curiosities of railway construction in early days of that industry was the scheming of routes and the methods of construction. After the completion of the Erie Canal from tide water to Lake Erie through the northern counties of New York State, violent agitation arose for the construction of a canal or other means of transportation through the southern counties of the State, which eventuated in the building of the Erie Railroad, the first trunk line ever constructed in any country.

The most plausible proposition about a trunk railroad to traverse the State of New York was to extend the line from New York City to Buffalo, but the property interest of leading promoters led the [illegible] building from Piermont on the Hudson River to Dun[illegible] Lake Erie.

[illegible] the promoters of the enterprise were ready to begin the work of construction in 1835, and on November of that year actual work was be[illegible] 177 [illegible] miles from Dunkirk. There was no apparent reason why the work of construction should be begun in the midst of a forest, but that seemed to be the way that rail-[illegible]

[illegible] ginning of construction of the Erie Railroad, at Deposit, New York, on the Delaware division, was duly celebrated, with all the pomp and ceremony to which such an important event in Erie history is entitled, on Saturday, November 6, and it will be inscribed on the pages of Erie's history as one of the important happenings during the existence of this great and growing railroad.

Complying with the kindly invitation extended by Deposit's alert and progressive Business Men's Association, to the officials of the Erie Railroad, to attend the anniversary, a special train of five cars was provided by the company and left Jersey City at 9 o'clock in the morning, arriving at Deposit at 1:30 p. m.

On arrival at the station the party found several thousand persons of Deposit and from many towns in Broome and Delaware counties awaiting their coming, bidding them welcome and to assist in making November 6 a real Red Letter Day for Deposit.

It [illegible] however, as the [illegible] and a cold atmosphere made chills creep over those who were there to celebrate. In fact, it was very much like November 6, 1905, when a monument dedicated to the occurrence seventy years ago, was unveiled and the orators made their speeches amid flurries of snow, and some of those taking part afterwards died from the effects of exposure.

[illegible] were there for a good time and they had it. Every building in town was decorated and almost everybody carried flags and souvenirs. The fakers, incidentally, were on the job, too, recalling past celebrations in New York, when these gentlemen trade on the credulity of the public by selling flags.

Automobiles were in waiting to convey the Erie contingent over the line of march covered by the procession and they were filled. The Business Men's Association did the rest. It was a civic parade, honored by two bands, one of Deposit, the other the Erie's famous Susquehanna band of Erie employees. And for a small place like Deposit the parade was a dandy and reflects credit on the town and its wide-awake citizens.

At the conclusion of the parade the Erie people were conveyed back to the station and participated in the orations delivered from a platform west of the monument, which stands in a little park close to the passenger station.

[illegible] DURING AFTERNOON EXERCISES AT THE ERIE MONUMENT NEAR THE DEPOT

In the evening there were other ceremonies enjoyed at the High School auditorium, at which Erie officials spoke. In this connection the ladies of the Civic Club furnished a most enjoyable spread and contributed to the entertainment as well, a feature being a vocal solo rendered by Miss Ida Steinman, a student at the Ithaca Conservatory of Music.

Among those present were Mr. Edward H. Mott ("Ed." Mott), formerly of the Passenger Department, and a famous writer of character sketches, who delivered an historical address; also Charles Maggatt, a retired Delaware division engineer, who is the sole surviving son of Horace Maggatt, who had a contract for grading from the Delaware River east for the first rail laying.

Standard Braking Ratio for Passenger Service

By WALTER V. TURNER, Assistant Manager Westinghouse Air Brake Co.

From previous references to this subject of proper braking ratio for passenger equipment cars it is obvious that a number of things must be considered in an attempt to fix upon a figure that will serve as a base for a standard braking ratio, for example, among the many things we have to consider in choosing the percentage or ratio for service operation is one, which at the present should be the determining consideration, namely, that a ratio of 90% is commonly accepted. This 90% for service braking is predicated upon at least 90 lbs. pressure in the brake pipe, a higher pressure than this being necessary only for the purpose of obtaining a higher braking ratio for emergency applications. If less than 90 lbs. is carried, it is self-evident that less than 90% for a full service application will result and this must be tolerated for the reason that uniformity in the interchange of cars either on the same road or with other roads would not be practicable, for it is the per cent. on the highest cylinder pressure that must control in interchange considerations, as maximum braking ratios based upon a lower brake cylinder pressure than 60 lbs. would result in a rough brake. The term service application is now being used in the sense of equilization while the term full service application upon which the 90% is predicated is with reference to the maximum service braking power permissible in service control of trains, that is to say, the maximum that permits of a flexible brake with reasonable freedom from shocks, wheel sliding and other undesirable effects.

Now we have previously stated that it would be well to consider a 90% braking ratio, based upon a 24-lb. drop in the auxiliary reservoir, and obtained in 7 seconds' time, not that 90% is absolutely the best ratio, but at the present time there are many more reasons for its retention than there are for an endeavor to change it, and when it is understood that the 90% braking ratio has been fixed upon as the maximum permissible for service or station stop performance, and that 24 lbs. reduction in the auxiliary reservoir pressure is determined upon as the most desirable quantity from which to realize it, the confusion arising from mixing maximum service braking ratio and equalization between the auxiliary reservoir and the brake cylinder will disappear. Both have been loosely termed full service brake applications, but do not necessarily have any connection with each other, as the latter may result when only 50 lbs. cylinder pressure is obtained, which may not give anything near the 90% braking ratio. In other words in one case one deals with braking ratio and in the other with cylinder pressure and the quantity or value of the latter has no bearing whatever upon what braking ratio is best or permissible for service braking, and in speaking of braking ratio for service work, I do not mean "all that a man can get" but of what he should get, and how it should be obtained in order to have a brake of maximum efficiency, all other things being considered.

The other controllable element that enters into the primary factors of uniformity in braking effect is that of time, that is to say, the time to make the 24 lbs. reduction and the time to realize the 90% braking ratio, should be predetermined long enough to insure such a sufficiently slow development of the braking ratio as will avoid severe bunching of the slack in the train, which, due to a more rapid rate of fall of brake pipe pressure in the front end of the train, would occur if not provided against, therefore it has been found that if 90% braking ratio is realized with a 24 lbs. reduction in 7 seconds' time, all the smoothness of operation necessary is obtained.

The 7 seconds' time in which to obtain the braking ratio given by the writer as requirements are generally accepted, or if not accepted are generally used in air brake practice of today, therefore it is not the intention to advance anything new in this respect, but to get the whole matter down to a precise and systematic statement and make known the reasons and establish a base for brake installations and foundation brake gear which shall be common to all. If the base here laid down is followed, uniformity of braking ratio is bound to result, as the quantity varies only as the brake pipe pressure varies, whereas if some one uses the equalizing [illegible] pressure as the base for 90% braking ratio simply because this 90% is recommended, the cars so braked will not operate harmoniously with others for which a higher auxiliary reservoir pressure was employed as a base from which to calculate the braking ratio.

The terms and methods here recommended have the additional virtues of being the only ones that can be generally applied, that is to say, they will fit all equipments, whereas if cylinder pressure is employed one will have to keep constantly in mind that the cylinder base may vary for each equipment. For instance, if we say 90% on a 60-lb. cylinder pressure, for the P. C. it will be 60/86 of 90, and for an equipment where 50 lbs. cylinder pressure was realized, the statement would have to be 50/60 of 90 and so on. As it is self-evident that the 90% braking ratio, if brakes are to operate harmoniously in the same train, all must obtain this 90% at the same rate and for the same reduction, and this reduction by a practically unanimous consent is 24 lbs., it would seem that there is not even room for debate as to the advisability, from an engineering standpoint, of using the expression that covers all cases. It is of course understood that no matter in what roundabout way the 90% braking ratio is expressed, it finally comes back to what is here proposed, and therefore the expression advocated does not change the values of any of the terms or change any conditions, simply wipes out a little of the useless verbiage and therefore simplifies the whole proposition to all those whom habit has not enslaved or who are new to the discussion.

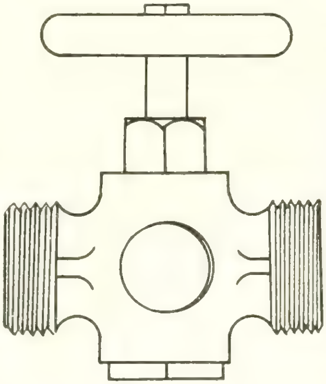
To permit of an intelligent understanding and application of what is involved in the term "braking power," we are compelled to divide it in two portions, one dealing with brake design and installations, and the other only with the stopping of trains, since the former involves only determinate factors and the latter involves extremely variable phenomena which can only be compensated for in any measure by varying the nominal braking ratio proportionately to the losses to be expected in any particular installation.

The factors of the retardation phase are, the time in which the cylinder pressure is obtained, the ultimate and continuous pressure realized, the efficiency of the foundation brake gear and the coefficient of brake shoe friction, that is the mean coefficient realized throughout the stop. Obviously, the brake apparatus which realizes the highest brake cylinder pressure in the shortest time and is most uniform in its action is the best brake apparatus, and as there is an apparatus that fills all present requirements in this respect it may be said that this is a fixed quantity, also the foundation brake gear having the highest efficiency, all other things being equal, is the best brake gear, and as this is purely a matter of design it may also be considered a fixed quantity. In the brake shoe we are confronted with the extreme problem as regards securing uniformity of retarding force, for the performance of this element of the brake apparatus is extremely variable, it having a range of over 300% according to conditions and circumstances.

In a future issue we will have something further to say in reference to brake shoe performance and the installation phase of this braking ratio problem, which is of growing interest.

Improved Ash-Pan Three-Way Blower Valve

By J. W. HAHN, Savannah, Ga.



The accompanying sketch shows an improved three way ash pan blower valve which has a packing nut and gland and requires little or no attention after being applied to the locomotive. It requires no grinding and can be operated freely with one hand.

Any one who has ever had any experience with the present type of ash pan three way blower valves can very readily see the advantages of the improved form of ash pan three way blower valve, over the older types. There are quite a few cases on record where fireman, engineers and hostlers have been severely scalded by steam escaping from around the stems of the older type of ash pan three way blowers, and there are no means of repairing the older type of ash pan blowers except by putting a washer under the valve and forcing it to the top of the cage, thus making the valve inoperative unless a large monkey wrench is available for the purpose of turning the valve.

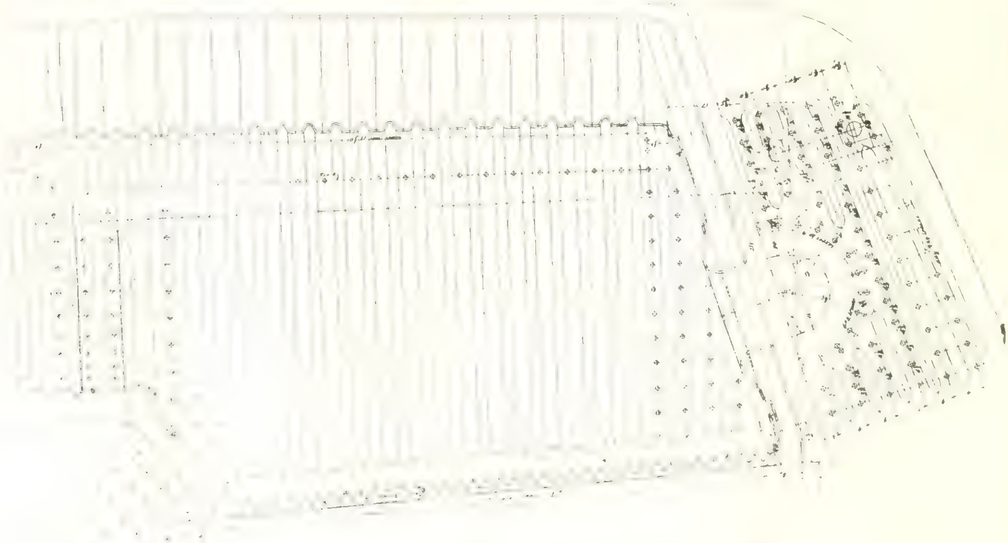
The present older type of three way ash pan blowers can be converted into one of the improved at very little expense and will soon pay for themselves, as they require practically no attention after being applied to the locomotive, other than an occasional packing. A bonnet with packing nut and gland is screwed into top of cage after cage has been drilled and tapped to receive same, then a longer stem of the proper size is attached to the valve, after which a hand wheel supplied with the proper signs to indicate the positions of the valve, such as closed front and back. The valve is then assembled and is ready for service.

Locomotive Boiler Equipped with Superheater Appliances Changed Into a Corrugated Fire-Box Boiler

By WM. H. WOOD, Mechanical and Constructing Engineer, Media, Pa.

The illustrations taken from the blue prints prepared by one of the locomotive companies will, no doubt, be of interest to all railroads, inasmuch as the phenomenal [illegible] surface in this type of boil[illegible] twenty per cent [illegible] per[illegible]

In the Wood boilers the total firebox and combustion chamber heating surface is 272 square feet. In the regular type of boiler the total heating surface is 218 [illegible] heating square feet. The number of stays in the [illegible] on account of the extra strength given to [illegible] shows a reduction of about 729 stays.



[illegible]

It will be noted that this extra firebox surface is clear gain, as the fire grate areas in both boilers are the same. In order to illustrate the gain, it will be remembered that a few years back the Master Mechanics' Association Committee came to the conclusion that the firebox heating surface was equal to ten to one of the tube surface.

R. M. K. Locomotive Valve Gear

By R. W. ROGERS, Instructor of Apprentices, Erie Railroad

The following is a proposed combination of the Klug and Marshall valve gear to switching locomotives. This gear has given good success in steamboat practice and where a slow speed is not exceeded as in switching service. A modification of this gear might be adapted for the locomotive.

The gear proper consists of three elementary parts, namely, floating lever, radius link, and radius guide. Fig. 3 shows the gear in forward motion front dead center. It is noted that the forward motion is obtained with

FIG. 1.

radius rod at bottom of radius guide as in Walschaerts gear. The valve gear in detail consists of a return crank located diametrically opposite crank pin or 180 degrees in rear of crank pin, thus having a positive angle of advance of 90 degrees; a floating lever, floating lever extension, radius link, radius guide, guide block, block hanger as in Fig. 3.

The operation of the valve consists of oscillation of floating lever about point "B" on radius link the radius link turning about pivot "D" on guide block and the motion of return crank "C" giving the point "A" a combination of the two motions cited, causing the valve to move in desired direction.

The valve shown in Fig. 3 is for outside admission; for inside admission it

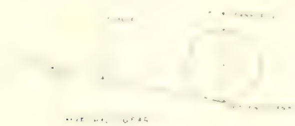
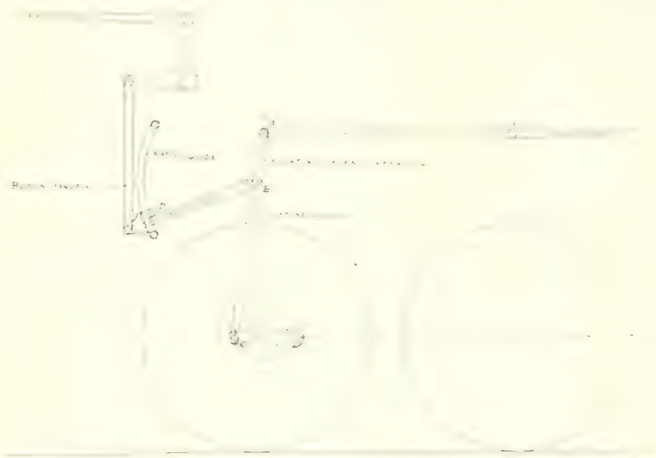


FIG. 2.

is simply necessary to place a rocker at end of valve rod "F," thus reversing direction of motion of valve on its seat.

The Kinematic diagram, Fig. 4, shows the relation of respective positions of crank pin, return crank, and valve giving a mid-gear travel of 1¾ inches, a total travel of 4½ inches, which with a lap of ⅝ in. and lead of ¼ in., would give a maximum cut-off of 87 per cent. The throw of return crank is approximately 6 in. The stroke of the locomotive can be anything desired. A valve diagram would give this analysis.

The return crank [illegible] some-what long; if constructed in usual manner, however, this will not be above the average length. A variation of the location of radius guide and length of radius rod can give any desired travel



to valve within practical limits. A long radius rod gives best results.

The possibilties of the use of gear are perhaps limited. The mechanical advantages in simplicity of design by elimination of any cross-head connec-

tion. However, for high speeds, as in case of Joy gear and others of like nature an irregular valve motion results.

The development from the Klug valve gear shown in Fig. 1, and Mar-[illegible] vertical cylinder engines; a combination of the two gears would give that shown in Fig. 3. Naturally, there is nothing new claimed for the gear, the Southern valve gear is really a Klug gear modified by changing the position of return crank—90 degrees. Hackworth invented a similar gear to the one described, in 1849. The possibilities for using it, however, are quite evident, the angularity of the connecting rod effecting the valve motion is confined to the middle of valve stroke instead of having its effect felt at end of valve stroke.

of interest to small locomotive users.

The Klug gear, Fig. 1, consists of a return crank or eccentric placed on same line as crank pin, with a negative [illegible] degrees. The motion of the gear is derived from return crank and point 3, swinging about point 2. The reversal of motion is obtained by shifting lever 2-3, in arc 2-2. By a variation in lengths of levers the point 4 can be given the desired motion, this point moving in path of an ellipse or loop. The Marshall gear, Fig. 2, is well known and needs little explanation. A combination of the principles involved in both these gears gives the R-M-K gear.

The proportions of the gear give constant lead. The ratio between the distance CB and BA should equal the ratio between diameter of return crank and twice the sum of lap and lead, or—

$$\frac{CB}{BA} = \frac{\text{Diam. of Return Crank}}{2\ (\text{Lap} + \text{Lead})}$$

One can change the proportions to suit the conditions of lap and lead desired.

False Economy and Its Results

By W. B. WAGNER, Montgomery, Ala.

Waste and Incapacity Piling Up Heavy Expenses

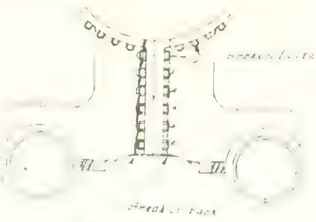
The limited force in many roundhouses and the determination to keep the wheels running is the cause of much needless expenditure, and a book could be written giving illustrations of [illegible] quences that would make interesting reading, but such a work would be like a voice crying in the wilderness. Like a wretched fire escape in a congested factory there is no time or means allowed until the disaster comes, and then the next calamity is in some other direction, and the lesson is forgotten.

A few illustrations from my own experience occur to me. A high-wheeled fast freight engine was allowed to break itself in two as shown in the sketch. It developed a mania for breaking saddle bolts that had never been fitted in the first place. Reports came in repeatedly that the engine was working at the saddle and a few bolts would be [illegible] the reports began again. This was kept up until the saddle went in pieces. [illegible] fitting bolts, hard usage, neglect, pounding and variations in expansion, and one bolt after another broke until the strain was too great for the unbroken bolts. After the collapse came an attempt was made to clamp the saddle, and in this condition the engine ran a few [illegible] reamed and the bolts properly fitted [illegible] plates.

Another engine had the driving [illegible] inch. It did not pay the railroad company to keep this engine in that con[illegible] three side rods, two main crank pins and three sets of tires were worn sharp on the flanges. A few hours work could have remedied the defect at any time, but there was no time allowed until the actual breakage happened.

Another ramshackle locomotive had such an amount of lateral play between the driving boxes and the hubs of the drivers that in passing around a curve one day the front crank pin caught under the crosshead, broke the crosshead, guide and cylinder head, and bent the guide yoke, main and side rods. Of course the blame was put on the inanimate frog, but it was observed that new hub liners were applied before the engine was sent out to seek its fortune again.

Still another overworked freight on



[illegible]

[illegible] and one day, figuratively speaking, lay [illegible] properly, or rather improperly, disci[illegible] being examined it was found that the link hanger pins and bushings were so [illegible] that one side the valve opening amounted to 13/16 in., while the other side, as if in a spirit of contradiction, was running blind by about 1/4 in. The gearing was rectified but the black mark remained on the engineer's record as originally entered.

Instances could be multiplied and doubtless every railroad man, especially those familiar with roundhouse work, knows from among the mass of reports made by engineers in regard to the condition of the engines, the roundhouse foreman and his available force can do little more than take what may be called a bite here and a bite there, and let the rest go until a more convenient season, which of course never comes, until the scrap heap comes literally to a standstill.

Now the worst feature of this system of deception is the fact that the motive power is not getting a fair chance to do its part of the work. Hence double-heading of trains and delays. I have seen passenger engines of the best type that were kept on the road month after month coughing as if they had tuberculosis of the lungs, and no wonder in cases where new rings were put in the valves they were worn so much that a knife blade could be inserted between the bushing and the packing without compressing the ring. It was impossible to fit rings to such worn bshings and yet some of these engines had just left the shops after undergoing what was called repairs, but what was really a coat of paint and a little refitting here and there. Now the cost of a few days double heading would pay for all the expense of rebushing or reboring the valve chamber. These [illegible] everywhere, but they are common enough on roads that are not the worst in the country. It occurs wherever mistaken economy and incompetence are connected with the maintenance of the motive power of railroads.

These instances could be added to, and while the enactment of the Federal laws has had a beneficial effect in many ways, it is a notorious fact that many locomotives running in the Mississippi valley and, I presume, elsewhere, are so choked up with mud that it would require a blast of dynamite to slack the solid rock that is allowed to gather around the firebox, and among the lower flues until sometimes one would marvel how the water can possibly circulate among them. As to piston valves, I do not recollect seeing any that were steam-tight in a very long time, so that I have ceased looking for them.

High-Powered Traffic Movement Illustrated

By F. M. NELLIS, Secretary American Air Brake Association

It is reported that the Pennsylvania Railroad moved between 188,000 and 190,000 cars over its Middle Division during the month of September, this being the greatest car transfer in the company's history. The real magnitude of such a movement is but vaguely expressed in the large figures given for the reason that we have become so accustomed to large figures that a few hundred thousand more or less make little impression upon us. However, the vastness of this achievement may be better emphasized by the following popular illustrations, their manifest absurdity supplying their own apology.

Suppose these cars were 188,000 in number and all were made to pass by a given point in 30 days (September), each car would have but 13.7 seconds in which to make its transit. Assuming that each car were thirty-five feet long, and all cars were coupled up into one train, the length of train would be about 1,262 miles. With the caboose, in New York City, the engine would be in Des Moines, Iowa. Assuming a two-cylinder locomotive having 30-inch stroke cylinders and 56-inch driving wheels, and carrying 200 pounds working steam pressure. The diameter of cylinders would have to be 53 feet to haul this train.

The area of the heating surface would approximate about 62 acres. The grate area would have to be nearly one acre. If the tracks were 72 [illegible] wide, to [illegible] sufficient coal [illegible] the [illegible] would [illegible] to be about [illegible] miles long. [illegible] the [illegible] would extend back to the 207th car. Using a good [illegible] economically, the fireman would have to throw 1¾ tons at each shovelful every three seconds. To feed sufficient water to the boiler, the injector pipes would have to be about 5 feet in diameter, and both injectors would have to be working most of the time. If the engineer should whistle the flagman back, and sound would carry that far, 1¾ hours would elapse before the sound would be heard at the caboose and the flagman would drop to the ballast. Allowing six inches total slack between cars (3 inches in each direction), the total amount of slack would be 18 miles. With the slack all extended, if the locomotive were to back up at the rate of 2 miles per hour, 9 hours would be required before slack was entirely bunched; and the locomotive would be standing on the spot where the 2,610th car had stood. At a sustained speed of 12 miles per hour, about 4 days and 12 hours would be required for this train to pass a given point. The switchman in his shanty would bid "Goodbye!" to the engineer Sunday night at midnight, and the shop whistle would be blowing for noon hour the following Friday before the watchman could shout "Hello!" to the conductor [illegible]

Causes of Undesired Quick-Action

By G. D. HALEY, Altoona, Pa.

I have read your publication of the Federal Law relative to locomotive brake maintenance in the October issue and consider it a very timely topic and it also proves to me that the air brake man who does not read the pages of Railway and Locomotive Engineering is missing some very valuable information.

I have also noted your answer to a question on the subject of undesired quick action in the November issue, asked by "W. J." and observe that the accurate location for the cause of this [illegible] the [illegible] various parts of the locomotive brake [illegible] examination of the engineer.

Recently an engineer reported the distributing valve working in quick-action during a service application on [illegible] engine in each instance and the list rack would disclose no disorder in any of the valves which I think calls for some other examination outside of the air brake [illegible]

My [illegible] does not actually occur every time it is reported and it is proven by the fact that when undesired quick-action occurs on passenger trains with the amount of universal equipments now in use he cannot get away without a stop or a detention and when he does not stop it is a pretty good indication that quick action did not occur or at least not the quick-action we are told about by the brake manufacturers.

We are also told that "loafing on lap" is an excellent way to start undesired [illegible] rack that will disclose such a disorder and take the stand that this disorder [illegible] the brake is largely imaginary.

[illegible] correspondent in that this disorder [illegible] stances, being worked to the limit and is frequently given as the cause of a rough stop or failure to make scheduled time when something other than the [illegible]

However, while the service and emergency [illegible] are separated, there were certain defects of mechanical construction in the emergency portion and the high-pressure cap of former types of valves which was responsible for certain cases of undesired quick-action, but when it comes to running down each individual case reported, in many instances no apparent cause can be found in the equipment and sometimes rightfully so, as in some cases the very application of the brake in quick-action in itself removes the disorder. This is, however, a subject that is entirely too broad to handle in the Correspondence columns and as an example of what may be encountered in tracing up such reports we will mention an incident of very recent occurrence in which a case of undesired quick-action developed during a brake test on a passenger train every other day. When the cause thereof was finally located it was found that a certain employee on a car in the train in some manner became obsessed with the idea that it was his duty to make a test of the conductor's valve on that particular car before each trip and decided that a good time to do so was while the brakes were being tested. (Ed.)

The Supreme Cutting Metal.

A new metal particularly adapted to machine tool work is coming into use, particularly well adapted to machine tool operators. It is called stellite and is an alloy of cobalt and chromium. By the addition of tungsten or molybdenum or both, very hard alloys are formed, capable of scratching any steel that can be produced suitable for cutting tools for machining iron and steel. The high value of stellite has been in its ability to maintain its cutting edge at high speed at temperatures which would cause the failure of any known tool containing a notable quantity of iron. A stellite tool ⅜ inch square by 2½ inch long, is reported, says the [illegible] turned off more than 8,000 pounds of [illegible] use. Considering only the portion of the tool ground away, it turned off 1,000 times its own weight.

We commend the notice of this invention to master mechanics and shop [illegible] promote shop efficiency. Remember the name stellite.

[illegible] New York, has been awarded the Tel[illegible] Civil Engineers (Great Britain) in recognition of his paper on "The Laxaxalpam Aqueduct Tunnels in Mexico" and his achievements in engineering.

Interesting Variety of Types of Locomotives for the Greek, Serbian, Belgian and Russian Governments

Built by The American Locomotive Company

While the passing year has been re-markable in many ways in the history of the American railroads, partly in the con-[illegible] of the [illegible] condition of business in the early part of the year, and latterly the highly improved condition that set in with the early fall, one remarkable outstanding feature has been the rapidity with which the needed supplies can be furnished by the manufac-[illegible] establishments engaged in the con-struction of railroad material. To the in-creased demand for railroad supplies has been added the great and growing de-mand for material from foreign countries. The locomotive companies have shown a readiness to meet any emergency that is beyond all praise. By way of illustration, twenty 2-8-2 type locomotives for the Greek Government Railways, ten 2-6-6-2 type and twelve 2-8-0 type locomotives for the Serbian Government, twenty 0-6-0-T type locomotives for the Belgian State Railways, one hundred 2-10-0 type locomotives and fifteen 2-6-0 type loco-motives for the Russian Government, have recently been delivered by the Am-erican Locomotive Company. These [illegible] foreign railways are accepting American design in order to facilitate delivery which at present is the important factor.

Greek Government.

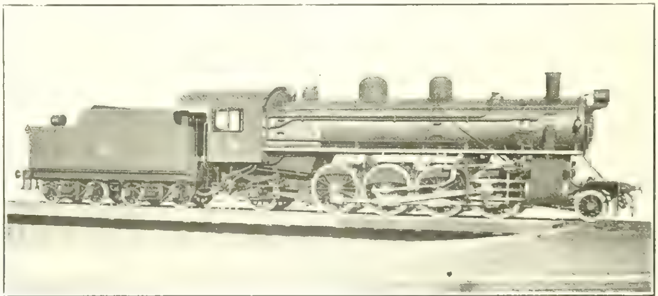
[illegible] de-livered to the Greek Government will be tested on a section of the road com-prised between the stations Lianocladi and Derely, a distance of 43 kilometers (26.72 miles). The major portion of the curves are 300 meters (984.3 feet) radius. Beginning from Lianocladi, and for a distance of 3½ kilometers (2.17 miles), the grades vary from .45 per cent to 2 per cent, then for a stretch of 30 kilometers (18.64 miles, a con-tinuous grade of 2 per cent; then for [illegible] grade of 2 per cent; and the remaining section to Derely is level.

[illegible] without taking water.

A guarantee was given that the loco-motives would haul with absolute secur-ity, on the section of road defined above, and without imposing hardship on the [illegible]

A train of 250 metric tons (275.6 tons) [illegible] meters (15.53 miles) per hour on the [illegible] at 60 kilometers (37.28 miles) per hour on the level. Second—A train of 190 metric tons (209.5 tons) back of tender at 40 kilometers (24.86 miles) per hour on the continuous grade of 2 per cent, and at least 80 kilometers (49.71 miles) per hour on the level. All the locomo-tives were completely erected and tried out under steam at the builder's works before shipment.

The firebox is of copper and is 83¾ inches long and 59¾ inches wide. The tubes have copper ends 6 inches long at the firebox end. All water-space stays are copper and have telltale holes drilled in both ends. While the boiler and grate surfaces are less than would be good practice in this country, they are as large as possible to be obtained within the imposed limitations of weight, and in comparison with continental loco-motives they represent liberal propor-tions.



MIKADO TYPE OF LOCOMOTIVE FOR THE GREEK GOVERNMENT

Among the interesting details are cylinder safety valves, by-pass valves and water gauge cocks. Cylinder safety valves are attached to each end of and underneath the cylinder barrel. The de-sign follows the builder's standard cylinder head relief valve with the ex-[illegible] connection with the cylinder. Advan-tage was also taken, in making this cast-ing, to accommodate a cylinder cock, thus avoiding any additional holes in the cylinder barrel. The by-pass valve dif-fers from practice in the United States in that it is operated from the cab by a system of levers. The water gauge cocks are designed to close automatic-[illegible]

Other details are steam heat equip-ment, electric headlights on both ends, self centering valve stem guide, Cole latest trailing truck, screw reverse gear, Le Chatelaier water brake, speed record-er and pyrometer. Engine and tender are equipped with vacuum automatic brakes as these brakes are now in use on the Greek roads. The use of air brakes is contemplated and the engines were therefore arranged so that air brakes can be supplied with the least possible trouble.

These locomotives follow American practice with the exception of threads. Metric threads were used on all bolts, boiler studs and staybolts.

The following are the general dimen-sions of these locomotives:

Greek 2-8-2 type:

Track Gauge—4 ft. 8 11/16 ins.

Fuel—Cardiff coal.

Cylinder—Diameter, 23 ins.; stroke, 26 ins.

Tractive Power—Simple, 33,120 lbs.

Factor of Adhesion—Simple, 3.98.

Wheel Base, Driving—15 ft. 9 ins.; rigid, 15 ft. 9 ins.; total, 32 ft. 2 ins.

Wheel Base Total, Engine and Ten-der—57 ft. 8 ins.

Weight in Working Order—187,500 lbs.; on drivers, 131,800 lbs.; on trailers, 31,500 lbs.; on engine truck, 24,200 lbs.; on engine and tender, 293,200 lbs.

Boiler Type, straight top radial; out-side diameter first ring, 62 ins.; working pressure 170 lbs.

Firebox—Length, 83¾ ins.; width, 59¾ ins.; thickness of crown, ⅝ in.; tubes, 3/16 and ⅝ in.; sides, ⅝ in.; back, ⅝ and 1-3/16 ins.; water space front, 4 ins.; sides, 3½ ins.; back, 3½ ins.; depth (top of grate to center of low-est tube), 23½ ins.

Crown Staying—Radial.

Tubes Material, cold drawn, seamless st.; number, 134; diameter, 2 ins.; thick-ness, No. 11, B. W. G.; length, 19 ft. 0 ins.; spacing ¾ in.

Flues—Material, cold drawn, seamless st.; number, 21; diameter, $5\frac{3}{8}$ ins.; thickness, No. 9, B. W. C.

Heating Surface—Tubes and flues, 1,881 sq. ft.; firebox, 134 sq. ft.; arch tubes, 16 sq. ft.; total, 2,031 sq. ft.

Superheater Surface—458 sq. ft.

Grate Area—34.7 sq. ft.

Wheels—Driving, diameter outside tire, 60 ins.; center diameter, 54 ins.; engine truck, diameter, 33 ins.; trailing truck, diameter, 42 ins.; tender truck, diameter, 33 ins.

Axles—Driving journals, main, 9 x 9 ins.; other, 8 x 9 ins.; engine truck journals, $5\frac{1}{2}$ x 12 ins.; trailing truck journals, 6 x 14 ins.; tender truck journals, 5 x 9 ins.

Brake—Driver, vacuum and hand.

Piston Rod—Diameter, $3\frac{3}{4}$ ins.

Smokestack—Diameter, 13 ins.; top above rail, 13 ft. 10 ins.

Tank—Capacity, 5,000 gallons; fuel, 8 U. S. tons.

Valves—Type—Piston; travel, 6 ins.; ex. lap. clear $\frac{1}{8}$ in.; setting, lead, 3/16 ins. constant.

Serbian Government Railways.

An order was received on February 9 for ten 2-6-6-2 Mallet locomotives of new design. All drawing room work was done in nineteen working days. The first engine had been designed, built, tested, knocked down and shipped on April 8.

These ten Mallets and the twelve Consolidations have outside frames which were necessitated by a gauge of track of 30 inches. Also as many details as possible were made interchangeable.

Being fitted with the builders' system of compounding, the ... tractive power working compound of 24,300 pounds, and 29,200 pounds working simple. By means of a brick wall, a grate 85 inches long by $39\frac{1}{4}$ inches wide is installed in a firebox $114\frac{1}{8}$ inches long by $39\frac{1}{4}$ inches wide. A screw reverse gear was also applied.

An order for seven of the Consolidation engines was received on January 12. This order was increased to twelve on January 28. Five of the engines were shipped on March 11 and the remaining seven were shipped on March 18.

American Locomotive Company's standard methods of design and construction govern these engines throughout.

The following are the general dimensions of these locomotives:

Serbian Government 2-6-6-2 type:

Track Gauge—30 ins.

Fuel—Soft coal.

Cylinder—Diameter, 13 ins.; stroke 20 ins.

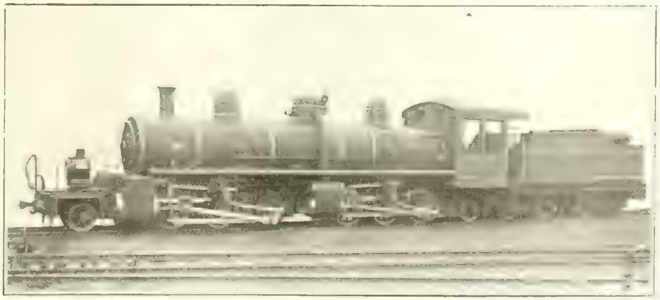
Tractive Power—Compound, 24,300 lbs.

Factor of Adhesion—Compound, 4.3

Wheel Base—Driving, 7 ft. 6 ins.; rigid, 7 ft. 6 ins.; total, 34 ft. 6 ins.; total, engine and tender, 55 ft. 0 ins.

Weight—In working order, 126,000 lbs.; on drivers, 103,000 lbs.; on trailers, 11,000 lbs.; on engine truck, 12,000 lbs.; on engine and tender, 156,500 lbs.

Boiler—Type, Straight top radial; outside diameter ... pressure, 200 lbs.



Firebox—Length, $114\frac{1}{8}$ ins.; width $39\frac{1}{4}$ ins.; thickness of crown, $\frac{3}{8}$ in.; tubes, $\frac{1}{2}$ in.; sides, $\frac{3}{8}$ in.; back, $\frac{3}{8}$ in.; water space front 4 ins.; sides, 3 ins. ... of lowest tube), $\frac{3}{8}$ in.

Crown Staying—Radial

... st.; number, 157; diameter, 2 ins.; thickness, No. 12, B. W. G.; length, 15 ft. $1\frac{1}{2}$ ins.; spacing 11/16 in.

Heating Surface—Tubes and flues, 1,236.5 sq. ft.; firebox, 95 sq. ft.; total, 1,331.5 sq. ft.

Wheels—Driving, diameter outside tire, 36 ins.; center diameter, 31 ins.; engine truck, diameter, 24 ins.; trailing truck, diameter, 24 ins.; tender truck, diameter, 26 ins.

Axles—Driving journals, main, $6\frac{1}{2}$ x 7 ins.; other $6\frac{1}{2}$ x 7 ins.; engine truck journals, 4 x 7 ins.; trailing truck journals, 4 x 7 ins.; tender truck journals, $3\frac{3}{4}$ x 7 ins.

Piston Rod—Diameter, $2\frac{3}{4}$ ins.

Smokestack—Diameter, 11 ins.; top above rail, 10 ft. 10 ins.

Tank—Capacity, 2,500 gallons; fuel, 5 tons of coal.

Valves—Type, Piston 7 ins.; travel $4\frac{3}{4}$ ins.; steam lap, $\frac{3}{4}$ in.; ex lap clear, 3/16 in.; setting lead, $\frac{1}{8}$ in.

Serbian Government 2-8-0 type:

Track Gauge—2 ft. 6 ins.

Cylinders—Diameter, 15 ins.; stroke, 20 ins.

Tractive Power—Simple, 17,000 lbs.

Wheel Base Driving, 10 ft. 7 ins., rigid, 10 ft. 7 ins.; total, 18 ft.; total, engine and tender, 42 ft. 8 ins.

Boiler—Type, straight top radial stay; outside diameter first ring, $47\frac{7}{8}$ ins.;

Firebox—Type, narrow; length, 48 3/16 ins., width, $39\frac{1}{4}$ ins.; thickness of crown, $\frac{3}{8}$ in.; tubes, $\frac{1}{2}$ in.; sides, $\frac{3}{8}$ in.; back, 5/16 in.; water space front, 3 ins.; sides, 3 ins.; back, 3 ins.; depth (top of grate to center of lowest tube), $20\frac{3}{8}$ ins.

Crown Staying—Radial

Tubes—Material, cold drawn, seamless st.; number, 126; diameter, 2 ins.; thick- ... ins.; spacing $\frac{3}{4}$ in.

... sq. ft.; firebox, 69 sq. ft.; total, 1,001 sq. ft.

Grate Area—13.1 sq. ft.

Wheels—Driving, diameter outside tire,

36 ins.; center diameter, 31 ins.; engine truck, diameter, 24 ins.; kind, C. I.; tender, truck diameter, 26 ins.; kind, C. I.

[illegible]—Driving journals, main, [illegible] x 7 ins.; others, [illegible] x 7 ins.; engine truck journals, 4 x 5 ins.; tender truck journals, [illegible] x 7 ins.

Engine Truck—Radial center bearing [illegible]. Style, rocking.

The following are the general dimensions of these locomotives:

Belgian State 0-6-0 type:

Track Gauge—3 ft. 3⅜ ins.

Fuel—Briquette coal.

Cylinders—Diameter, 11½ ins.; stroke, 16 ins.

Tractive Power—Simple, 7,300 lbs.

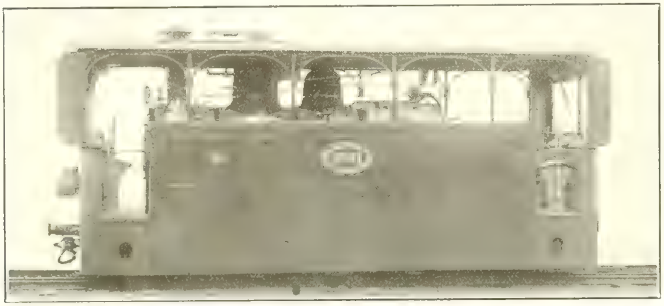
Factor of Adhesion—Simple, 6.6.

Piston Rod—Diameter, 2¼ ins.; piston packing, C. I. rings.

Smokestack—Diameter, [illegible] ins.; top above rail, 10 ft. 6 ins.

Tank—Style, one on each side of engine; capacity, 528 gallons; fuel, 1,100 lbs. coal.

Valves—Type, Richardson balanced; travel, 4 ins.; steam lap, ⅝ in.; ex. lap, line and line; setting, 1/16 in. lead.



[illegible] TYPE OF LOCOMOTIVE FOR THE BELGIAN STATE RAILWAYS.

Piston Rod—Diameter, 2¾ ins.

Smokestack—Diameter, 11 ins.; top above rail, 11 ft.

Tank—Capacity, 2,000 gallons.

Valves—Type, balanced; travel, 4½ ins.; steam lap, 13/16 in.; ex. lap, line and line; setting, lead, [illegible] in full gear.

Belgian State Railway.

[illegible] type locomotives of unique design were ordered on June 2, and the first engine was shipped on August 19.

In Belgium [illegible] in the cities, all interurban traffic is handled by small steam engines of unique design. These engines haul passengers and produce to the distributing centers in the large cities as the tracks connect with the electric lines.

As the soil is of a very sandy nature, [illegible] so as to exclude the dust. Having outside frames, the enclosing sheet metal [illegible] the bottom of the side tanks. Five swinging doors on each side allow access to the moving parts.

[illegible] operation from either end. The throttle and reverse lever handles are fitted with a steel link which holds the latch levers in an open position when engine is being [illegible] down between the frames for repair. Ten engines have steel tubes and steel fireboxes and the other ten have brass tubes, copper fireboxes and copper stay-[illegible] stalled on each end.

Wheel Base—Driving, 6 ft. 6 ins.; rigid, 6 ft. 6 ins.; total, 6 ft. 6 ins.

Weight—In working order, 58,500 lbs.; on drivers, 58,500 lbs.

Boiler—Type, Belpaire; outside diameter first ring, 42 ins.; working pressure, 180 lbs.

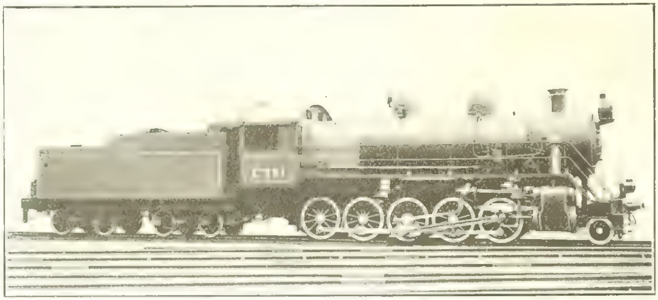
Firebox—Length, 42 ins.; width, 28 ins.; thickness of crown, [illegible] in.; tubes, [illegible] in.; sides, [illegible] in.; back, [illegible] in.; water space front, 3 ins.; sides, 2[illegible] ins.; [illegible]

Russian Government.

An order for one hundred 2-10-0 type locomotives for the Russian State Railways was placed on June 17. Delivery being an important factor makes it interesting to note several stages of construction. Design was entirely new. Drawing room work was started June 19, and the design was completed and the material ordered by July 15. First engine was built, tested under its own steam, knocked down, boxed and shipped by August 18.

The factor of adhesion is 3.39. This factor of adhesion is considerably less than what would be considered as good American practice, but European engines do not work at the same cut-offs as used in this country. This reduces their figure for tractive power and necessarily increases the factor of adhesion.

The boiler is of the straight top, radial stay type. It is 70¼ inches outside diameter at the front end and contains 195 2-inch tubes, 17 feet long. It is also fitted with a 28-unit Schmidt superheater. The



[illegible] LOCOMOTIVES FOR THE RUSSIAN STATE RAILWAYS.

[illegible] grate to center [illegible]

Tubes—Material, brass; number, 144; [illegible] No. 13, B. W. G.; length, 6 ft. 4 ins.; spacing, ⅝ in.

[illegible] 354 sq. ft.; firebox, 39 [illegible]; total, 393 sq. ft.

[illegible]

Wheels—Driving, diameter outside tire, 34 ins.; center diameter, 29¼ ins.

[illegible] 7 ins.; others, 6 x 7 ins.

[illegible]

firebox is of copper and is 107¾ inches long by 85¾ inches wide, and has copper water space stays with tell-tale holes drilled in both ends. A Security fire brick arch supported on tubes was also included.

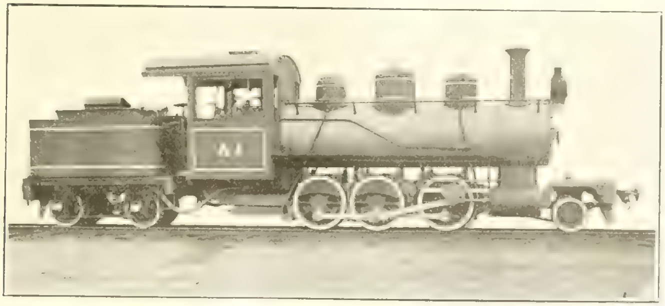
An interesting feature is an arrangement whereby the by-pass valves are operated by the superheater damper cylinder. Ordinarily, the damper cylinder receives steam from the steam pipe and therefore operates a short time after the throttle is opened. The by-pass valves have to close immediately when the throttle is opened. This necessitated changing the steam con-

nection for the damper cylinder and connecting it to the turret with an intervening control valve connected to the throttle. By this change steam is instantaneously admitted to the damper cylinder when the throttle is opened and the by-pass valves are immediately closed. In a similar way the by-pass valves open when the throttle is closed.

Connections on front and back knuckle pins are made by ball joints. This eliminates the bending strain on side rods when engine is on curve. Lateral motion on first and fifth drives will allow engines to operate on curves up to 700 feet radius on main line, with a possibility of entering curves of 300 feet radius occasionally.

Other features included are I section guides, outside steam pipes, extended piston rods, Rushton air operated screw reverse gear, Zara throttle, pyrometer, radial buffer, Franklin firedoor, Le Chatelier water brakes on fifty engines, and Russian Westinghouse brakes.

Fifteen 2-6-0 type locomotives were ordered for the Peter the Great Fortress Reval on July 2. The first engine was



2-6-0 TYPE OF LOCOMOTIVES FOR PETER THE GREAT FORTRESS REVAL, RUSSIAN GOVERNMENT STATE RAILWAYS.

shipped on September 10. This was an entirely new design, but followed American practice. These engines have a gauge of track of 750 MM. (29.53 inches).

Having cylinders 11 inches in diameter by 16 inches in stroke, boiler pressure of 165 pounds, and [illegible] 33½ inches in diameter, they have a tractive power of 8,100 pounds. The boiler is of the straight top type, is 36⅝ inches outside diameter at the front end and contains 85 2-inch tubes, 10 feet 6 inches long. The firebox is 40½ inches long and 33 inches wide and burns soft coal.

The tender is of the 4-wheel rigid pedestal type and has a capacity of 700 gallons of water and 1½ tons of coal.

The following are the general dimensions of these locomotives:

Russian Government State Railways 2-10-0 type:

Track Gauge—5 ft.

Fuel—Soft coal.

Cylinders—Type, piston valve; diameter, 25 ins.; stroke, 28 ins.

Tractive Power—Simple, 51,500 lbs.

Factor of Adhesion—3.4.

Wheel Base.—Driving—18 ft. 8 ins.; rigid, 18 ft. 8 ins.; total, 27 ft. 10 ins.; total, engine and tender, 60 ft. 1½ ins.

Weight—In working order, 195,000 lbs.; on drivers, 174,000 lbs.; on engine truck, 21,000 lbs.; engine and tender, 330,332 lbs.

Boiler—Type, straight top, radial stay; outside diameter first ring, 70½ ins.; working pressure, 180 lbs.

Firebox—Type, wide; length, 107⅝ ins.; width, 86 ins.; thickness of crown, ⅝ in.; tubes, 1 in. and ⅝ in.; sides, ½ in. and ⅝ in.; back, first 50, ½ in; last 50, ⅝ in.; water space front, 4 ins.; sides, 3½ ins.; back, 3½ ins.; depth (top of grade to center of lowest tube), 21 ins.

Crown Staying—Radial.

Tubes—Material, cold drawn, seamless steel; number, 195; diameter, 2 ins.; length, 17 ft.; spacing, ¾ in. F., 11/16 in. B.; thickness, No. 12, B. W. G.

Flues—Material, cold drawn S.S. for 75 engs, hot rolled S.S. for 25 engs.; number 28; diameter, 5⅜ ins. No. 9.

Heating Surface—Tubes and flues, 2,386 sq. ft.; firebox, 176 sq. ft.; arch tubes, 24 sq. ft.; total, 2,586 sq. ft.

Superheater Surface—553 sq. ft.

Grate Area—64.4 sq. ft.

Wheels—driving, diameter outside tire, 52 ins.; center diameter, 46 ins.; material, main, cast steel; others, cast steel; engine truck, diameter, 30 ins.; kind, C. S. spoke; tender truck, diameter, 36 ins.; kind, solid forged steel.

Axles—Driving journals, main, 10½ x 12 ins.; others, 8½ x 12 ins.; engine truck journals, 5½ x 10 ins.; tender truck journals, 5½ x 10 ins.

Boxes—Driving, main, cast steel; others, cast steel.

Engine Truck -2 wheel radial.

Piston Rod—diameter, 4½ ins.

Smokestack—Diameter, 17½ ins.; top above rail, 14 ft. 11 9/16 ins.

Engine Truck, 2 wheel radial.

[illegible] 7,400 [illegible] 8 metric tons of coal.

Valves—Type, piston, 12 ins.; travel, 6½ ins.; steam lap, 1¼ in.; setting, ⅛ in. lead.

Peter the Great Fortress Reval, Russian Government State Railways 2-6-0 type:

Track Gauge—750 MM. (29.53 ins.).

Fuel—Soft coal.

Cylinders—Type, simple; diameter, 11 ins.; stroke, 16 ins.

Tractive Power—Simple, 8,100 lbs.

Factor of Adhesion, simple—4.1.

Wheel Base—Driving, 6 ft. 6 ins.; rigid, 6 ft. 6 ins.; total, 12 ft. 6 ins.; total, engine and tender, 26 ft. 9 ins.

Weight—In working order, 37,265 lbs.; on drivers, 33,376 lbs.; on engine truck, 3,889 lbs; engine and tender, 54,705 lbs.

Boiler—Type, straight top; outside diameter first ring, 35⅝ ins.; working pressure, 165 lbs.

Firebox—Length, 40½ ins.; width, 33 ins.; thickness of crown, 5/16 in.; tubes, ⅜ in.; sides, 5/16 in.; back, 5/16 in.; water space front, 2¼ ins.; sides, 2¼ ins.; back, 2¼ ins.; depth (top of grade to center of lowest tube), 15 27/32 ins.

Crown Staying—Radial.

Tubes—Material, steel; number, 85; diameter, 2 ins.; thickness, No. 12; length, 10 ft. 6 ins.; spacing, 9/16 in.

Heating Surface—Tubes, 463 sq. ft.; firebox, 41 sq. ft.; total, 504 sq. ft.

Grate Area—9.3 sq. ft.

Wheels—Driving, diameter outside tire, 33½ ins.; center diameter, 29 ins.; engine truck, diameter, 20 ins.; kind, C. I. Plate; tender truck, diameter, 24 ins.; kind, C. I. Plate.

Axles—Driving, journals, main, 5 x 6 ins.; others, 5 x 6 ins.; engine truck journals, 3½ x 6 ins.; tender truck jour- [illegible]

Boxes—Driving, main, C. I.; others; C. I.

Engine Truck—Radial.

Piston Rod—Diameter, 2 ins.; piston packing, C. I. Ring.

Tank -Style, U. shape level top; capacity, 700 gallons; fuel, 1½ tons.

Valves -Type, plain "D"; travel, 3¼ ins., steam lap, 7/16 in.; setting, 1/16 in. lead in full gear.

Winning Peace.

[illegible] subterfuge or agreement; no peace is [illegible] which we shall win by victory over shame or sin—victory over the sin that oppresses, as well as that which corrupts. [illegible] every righteous nation must be whetted [illegible]

Catechism of Railroad Operation

Throwing Fire—Broken Boiler Check—Burst Flue—Working Steam Expansively—Foaming and Priming—Injectors and Lubricators—Engineer's Duties

Third Year's Examination.

[illegible] 374, November, 1915.)

Q. 300.—In case of an engine throwing fire, what would you do?

A.—Work engine as light as possible [illegible] fire, notify the superintendent and master mechanic, repair if possible and if could not repair would bring train in if engine did not throw too much fire, otherwise would have to reduce train or set all of train out and come in light, report defect and have repaired.

Q. 301.—On what part of boiler is the greatest strain?

A.—On the mud ring on account of the weight of water which is .447 of a pound per sq. in. one foot high, plus steam pressure.

Q. 302.—In case of boiler check valve becoming broken or it would not seat, what would you do?

A.—Close feed water valve if I had one, if not, reduce pressure (keeping water up) disconnect hose and plug feed pipe connection and screw hose back, close overflow valve and proceed with one injector.

Q. 303.—If injector fail while on the road, what would you do?

A.—Would close throttle to save what water I had, and try to locate and repair the trouble.

NOTE.—To locate the trouble, examine tank valve to see if it was open, see if there was any water in tank, if tank valve had come disconnected shut, would close overflow and blow it off from seat by opening main steam valve, if no water in tank, bank fire to protect crown sheet and [illegible] ply of water. If trouble is in injector and it is impossible to repair, smother or kill fire before water gets too low.

Q. 304.—If wash out plug blew out, or blow off cock would not close, or you had [illegible]

A.—Keep water up as high as possible and smother fire by covering stack and putting blower at work, or kill fire.

Q. 305.—What would you do if you had a badly leaking or burst tube?

A.—If a lower tube would cover with coal, if an upper tube would plug it with a sapling or piece of wood to keep the water from getting into the fire and bring in a full train if possible.

Q. 306.—What is necessary when fire is drawn in freezing weather?

[illegible] izing reservoir and auxiliary reservoir (if engine has the old style of brake), open drain cock to air pump, let all the water out of tank, and disconnect all pipes where water is liable to collect, let water out of boiler after it gets cold if necessary to prevent freezing.

Q. 307.—What should be done if grates were burned out while on the road?

A.—Cover the hole up with pieces of iron or stones, spread fire over the spot and come on; avoid shaking that section of grates.

Q. 308.—Why should ash pan dampers and slides be kept closed while on the road?

A.—To prevent live coals from falling out and setting fire to ties, etc.

Q. 309.—How high should water be carried in boiler to get the best results? Why?

A.—As high as possible and not work it over into cylinders, because the feed water does not have so great a cooling effect and the temperature is more easily held even, and the engine will steam better and on less fuel. Besides, if the injectors fail you will have water enough to enable you to locate and repair the trouble.

NOTE.—The water should never be allowed to get below the lower gauge cock and should at all times be high enough to protect the flues and crown sheet when pitching over a summit.

Q. 310.—How rapidly should water be supplied to a boiler?

A.—Just as fast as it is being used.

NOTE.—There are exceptions. Where the road is undulating it is a good practice to lose a little water on the heavy up grades and gain it back on the down grades or on the level.

Q. 311.—How can a locomotive be run most economically?

[illegible]

Q. 312.—What is the meaning of "working steam expansively"?

A.—By cutting off a small volume of steam in cylinder when piston has only traveled part of the length of its stroke, and confining it in cylinder compelling it to expand against the piston to the completion of its stroke.

Q. 313.—What is saturated steam, wet steam, superheated steam, wire drawn steam?

A.—Saturated steam is steam carrying small particles of water, it is in contact with water and has less than three per cent. of moisture in it. Wet steam contains more than three per cent. of moisture. Superheated steam is steam that has been heated over and has all the moisture turned into vapor. Wire drawn steam is steam that has been drawn through a small opening and expanded into a larger chamber and has its pressure reduced.

Q. 314.—What is the temperature of water boiling under atmospheric pressure? Under 200 pounds pressure.

A.—212 degrees Fahrenheit under atmospheric pressure and 387 degrees Fahrenheit under 200 pounds pressure.

Q. 315.—Does water expand, and if so how much under atmospheric pressure, and how much under 200 pounds pressure?

A.—Yes, it expands about 1,700 times (to be exact, 1,646), under atmospheric pressure and 140.8 times under 200 pounds pressure.

Q. 316.—What examinations should be made after any repairs have been made?

A.—Would see that all bolts, nuts, set screws and cotter keys are in place and properly tightened.

Q. 317.—What especial attention should be given an engine after work has been done on valves or brasses?

A.—Would place the engine on the quarter and handle reverse lever from one corner of the quadrant to the other to be sure that valve moved freely the entire length of its stroke, then admit steam (and with a piston valve which was inside admissional would have to handle reverse lever to get an exhaust) to try joints in steam chest to know that they were tight.

For brasses would see that they were properly keyed and that they moved freely at all points of the revolution, and that all keys and set screws, bolts and nuts and cotter keys were in place and tight.

Q. 318.—What attention should be given such boiler attachments as gauge cocks, water glasses, etc.?

A.—They should be tried to make sure that openings are free from scale and that the mountings in water glass will shut off, compare water glass with gauge cocks and be sure that the water moves up and down when engine is in motion.

Q. 319.—Is water glass safe to run by if the water is not moving up and down when engine is in motion?

A.—No, one of the openings is stopped [illegible]

Q. 320.—What is foaming? What is priming?

A.—Foaming is the action of impurities in the water. Priming is the result of getting too much water into boiler.

Q. 321.—What would you do in case of foaming? In case of priming?

A.—Ease off on throttle, open cylinder

cocks, and try to locate the true water level, and at first water tank would flush tank to purify water, then fill boiler and blow it off to purify the water in boiler. In case of priming would open cylinder cocks, ease off on throttle and shut off injectors, work engine lower down if necessary until I had the water at the proper level.

Q. 322.—What danger is there from an engine foaming? What is the danger when an engine primes?

A.—There is danger of burning the crown sheet when an engine foams. There is danger of breaking packing rings, knocking out cylinder heads, bending piston rods and washing the lubrication from the walls of cylinder.

Q. 323.—If the water disappeared from water glass on your closing the throttle what would you do?

A.—Would open throttle and try to raise the water. If drifting into a station or had to stop would hook reverse lever up to center and open cylinder cocks. NOTE.—If could not raise the water would bank fire to protect crown sheet.

Q. 324.—What work about an engine should be done by the engineer?

A.—Setting up wedges, keying up rod brasses and other necessary work while on the road to insure a successful trip.

Q. 325.—With one link blocked up what should be guarded against?

A.—Guard against reversing the engine or working the good side any lower down than you have the disabled side blocked at, unless you know that the lifting arm will clear the link head.

Q. 326.—What is an injector and what two classes have we?

A.—An injector is a machine which will force water into a steam boiler against a pressure greater than that which affords the power. We have two kinds of injectors, the lifting and the non-lifting.

Q. 327.—What is the difference between the lifting and the non-lifting injectors?

A.—The lifting injector has parts that form a vacuum and raise the water up to the injector, which is placed above the head of the water, then it has parts that force the water into the boiler, the non-lifting injector is placed below the head of water, and has the water run into it consequently all it has is the parts that will force the water into the boiler.

Q. 328.—What are the principal parts of an injector?

[illegible] overflow nozzle, main steam valve, priming valve, overflow valve, overflow chamber, combining, condensing and delivery tubes, priming tube and water regulating valve.

Q. 329.—What are the principles of operation of an injector?

A.—Vacuum forming and forcing during which an induced current is formed.

Q. 330.—What is a lubricator?

[illegible] oil regularly, under varying pressures to the steam chests and cylinders of an engine.

Q. 331.—What are the principal parts of a lubricator?

A.—Condensing chamber, oil reservoir, water tube, oil tubes, upper and lower feed arms, feed valves, water valve, steam valve, choke plugs, equalizing tubes and sight feed glasses and feed tips.

Q. 332.—What are the principles of operation of a lubricator?

A.—Condensation, equalization and gravitation.

NOTE.—Oil is raised to choke plug openings by the weight of the water which is condensed and then it flows to the steam chests through the tendency of a fluid to find a lower level.

Q. 333.—What means have you of telling the steam pressure on the boiler?

A.—The steam gauge.

Q. 334.—Why should strict attention be given to the blowing off point of safety valves and this pressure compared with steam gauge?

A.—So as to immediately know any irregularity in gauge or safety valves and not carry an excessive pressure.

Q. 335.—If spring in safety valve broke what would you do?

A.—Would force valve down solid, if spring was not long enough would cut piece of bolt and put it in and screw set screw against it, rely on keeping pressures under control and other safety valve taking care of the excess.

Q. 336.—What is generally the cause of second injector failing and what would you do to obviate it?

A.—Lack of use has caused corrosion of the tubes. Would use it alternately with the other injector.

Q. 337.—How are accidents and engine failures best avoided?

A.—By a thorough inspection and reporting all necessary work, and by the engineer doing any necessary work while on the road.

Q. 338.—What are the advantages of the combination boiler check?

A.—It reduces the number of holes in the boiler, and work can be done on check valve without reducing the steam pressure.

Q. 339.—In reporting work on any truck or engine wheel, how should it be designated?

[illegible] the leading engine truck wheel as number one.

Q. 340.—In reporting work, why is it [illegible] "pump won't work," "injector won't work"?

[illegible] termine the exact cause of the trouble and report it so that shop force can go right to the trouble and repair it without [illegible] not have steam on by time machinist is [illegible] boxes to report, why not report them all to be packed?

A.—Would determine by inspection and feeling which ones to report. It is not necessary to have boxes that are running all right disturbed nor is it good practice to disturb the packing when a box is running all right, it is liable to make it run hot.

Q. 342.—Why is it bad practice to stir the packing on top of a box with spout of oil can?

A.—It works the sand and grit down on to bearing and stops up oil holes.

Q. 343.—Is it necessary to use oil with the grease on crank pins?

A.—No, it is not, and it will wash off some of the grease.

Q. 344.—Why should engine oil not be used on valves and cylinders?

A.—Because it will not lubricate them but turns into a gas and explodes.

Q. 345.—At what temperature does engine oil lose its lubricating qualities?

A.—At from 290 to 310 degrees Fahrenheit, it is called the flashing point.

Q. 346.—At what temperature does valve oil lose its lubricating qualities?

A.—Valve oil for saturated steam loses its lubricating qualities at from 400 to 450 degrees and valve oil for superheaters will stand from 500 to 650 degrees Fahrenheit before it will flash.

Q. 347.—When valves appear dry when working steam and lubricator is working all right, what would you do?

A.—Ease off on throttle for a moment and allow oil that was held back in pipe to flow to steam chest. NOTE.—It is on account of the greater pressure in steam chest that oil is held up in pipe, and by easing off on the throttle you allow the pressure to become lower and the oil goes to the valve.

Q. 348.—What are the engineer's duties on arrival at the terminal before leaving engine?

A.—Shut off lubricator and all oil feeds. Ease off on air pump throttle so pump will work slow, fill boiler with water, leave fire with a bank that will hold until hostler comes, see that throttle is closed and fastened shut, have reverse lever in center and cylinder cocks open, put blocking under the drivers, see that all tools and lights are properly cared for, inspect engine thoroughly and report the work [illegible] thing in the cab and firebox, then climb [illegible] and everything between the engine and tender, then going down the right side inspect all parts thoroughly and going around front of engine [illegible] and then go down the left side and along [illegible] rear of tank [illegible] at same [illegible] entire engine.

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Training as Firemen.

[illegible] ing as the future locomotive engineers, [illegible] have frequently been made upon the present firemen. Some railroads may be careless concerning the character and the educational attainments of the men they hire as firemen, but that is not the rule, and our experience has been that the railroads [illegible] in charge consider will develop and train [illegible] that the selection of men for firemen is as [illegible] all other responsible positions where in- [illegible] ployer.

A report recently published says: "The committee recommend that a special official should have charge of the hiring and training of firemen. The applicants should be carefully chosen, and after a short time any man who does not come up to the standard should be weeded out. Then there should be a systematic effort on the part of every railway to educate and develop the men who are employed as new firemen, so that when they start firing they have a clear idea of what is before them. In the first place the prospective fireman should be given a position about the round house in some capacity, such as a wiper, machinist helper, or on the cinder pit. If there are shops there, or at the terminal, new men can be placed there. They will thus get experience that will be of value to them, after they get on the road as firemen and even after they are engineers. At first they should make a few trips with posted crews. With some instruction in chemistry of combustion they will develop into firemen at once, instead of taking months or years, as is now the practice. The future is full of high possibilities."

That report was signed by a full committee, but we strongly suspect that it was prepared by a cinder pit scientist.

We have no fault to find with the method pursued of training firemen. When the writer was in active engine service, a bright stout young man was at that time drawn from any occupation, such as a farm, or from the list of brakemen and started the practical work of firing with the instruction given by the engineer. An ordinarily intelligent young man finds no difficulty in acquiring the art of firing in the course of two or three trips doing the work.

The writer's experience has been edify- [illegible] Extensive extensions of the road were going on and numerous additions of the motive power men going on so that new engineers and firemen were being put weekly into service. The master mechanic in charge conceived the idea that firing [illegible] experience [illegible] the new men. In the course of three months twelve different firemen had wrestled with the steam making of my engine. Most of them were young country men, and they fired satisfactorily after the first trip. The exceptions were a baggage man and two clerks. There was a long grade about the middle of the division which kept the fireman busy. When near the top of this grade, the baggage man climbed up on his seat and swore that he would not throw another scoop if the company paid him $100 a day. I fired to the top of the grade and then put the baggage man off the engine, for which I was threatened with prosecution. Two office clerks who were ambitious to become engineers failed on account of blistered hands.

The work of firing a locomotive is no child's play, but it involves neither elaborate skill or very strenuous labor. Scientific knowledge is helpful, but it is no more essential than it is to the occupation of operating an engine lathe.

Scarcity of Freight Cars.

Only a few short months ago a pleasant amusement for people who enjoy wading in statistics was figuring on and guessing at the number of freight cars standing idle on railroad sidings; today the long rows of empty freight cars have disappeared, and we hear the old complaint repeated about the ruinous scarcity of freight cars.

The latest report of the American Railway Association shows a reduction of 76,000 in the number of surplus freight cars during the month of August. The total surplus on September 1 was only 159,919, as compared with 266,312 on August 1. The surplus on September 1 of this year was, however, still 24,000 greater than on September 1, 1914.

Since these figures were first published, the movement of crops and the increased use of cars to carry freight, resulting from a decided revival of general business, has put nearly all the idle cars into train service and we are already hearing abuse of some railroad companies because they are not providing all the cars needed to move the freight offered for transportation. There is an impression widespread among the public that railroad companies are nearly always short of cars, but the contrary is the case. It is only when cars are scarce that complaints are heard from freight shippers, and then howls are heard loud and deep. On nearly all railroads there is a short period annually when an abnormal volume of freight is offered for movement. When sufficient cars are provided to meet that rush of business, a great body of idle cars must be kept standing on sidings the remainder of the year.

The problem facing railroad companies during most of the time is not how to provide cars to move the freight offered, but to find the freight that will pay the interest on the capital represented by the cars belonging to the company. We notice that the present spirit of business is not moving many railroad companies to order new cars.

Reading and Study Among Railroad Men.

At this season of this year, when publishers and agents are looking for renewals of subscribers, as well as additions to their lists, it is gratifying to us to experience the fact that there is a marked improvement already manifested among railroad men to take advantage of the

opportunities to keep themselves informed in regard to the latest details of changes and improvements in the appliances with which they are expected to be familiar. It was said by a wise man that "reading maketh a full man, speaking a ready man, and writing an exact man." Of these three qualities the man who is full of information in regard to his work as a railroad man is the one most likely, not only to hold his position, but to get promotion, and a fulness of knowledge comes very slowly if one depends entirely on personal experience. In fact it is like a man trying to cut his way through a thick jungle when there is a well-paved road near-by where others are now traveling in comparative ease.

Yet among the young railroad men, and others not so young, we occasionally hear of some who claim that they have no time to read. This is a gross error, a mere matter of self-deception. They simply have not cultivated an inclination to read, and it will be observed of them that if the time comes when they have to be examined in regard to their fitness for promotion, a frantic effort will be made to obtain a sufficient amount of superficial information in the hope of meeting the requirements of the occasion.

We would urge it with all the unction that we possess that the railroad man who does not read cannot keep abreast in his calling. If he cannot find time to read, he should not expect others who contrive to find time to read and study can also find time to instruct him, and so he cannot do other than fall behind those who give their calling more serious attention. The result will be that, if such a man lives long enough, he will get time to think, and of course in his ignorance he will ascribe his failure in life to other causes than his own prolonged wilderness of wasted opportunities. Reading not only fills the mind, but it sharpens the quality of observation, enlarges the mental vision, and men naturally and properly become more valuable the more that they know. The habit of reading is the well-ballasted track to knowledge, and knowledge is the sure passport to advancement. Hence he who would advance must read. Others merely remain hewers of wood and drawers of waters or cleaners of engines or shovellers of coal.

The New Year is a popular time for new resolutions. Let us highly resolve to know more. We cannot always make opportunities, but we can always prepare for them, and when they do come we will be, to some extent, ready, and thus climb on stepping stones of our dead selves to nobler things. We should not pray for success. We should be worthy of it. If it be slow in coming, let us believe that quest is sometimes better than conquest, just as trial is often better than triumph.

Fraudulent Patent Claims.

The U. S. Circuit Court of Appeals for the Fourth Circuit, at Richmond, Va., handed down on the 6th inst. a decision affirming the decision of District Judge Rose, of Baltimore, in the suit of John B. Tate vs. the Baltimore & Ohio R. R. Co., directing a verdict for the defendant. The Tate Patent sued on No. 643,560, dated February 13, 1900, which was for a furnace bearer or expansion pad, was held by Judge Rose and by the Court of Appeals to be invalid, and fully anticipated by the Sharp British Patent No. 3,558 of 1879.

The decision is of importance to a number of railroad companies, as the suit was an attempt to cover and collect damages of $22,477.50 for the use of the well known expansion attachment of the firebox to the frames through the mud ring instead of through the side sheets, and if the decision of the Court of Appeals had been adverse to the Baltimore & Ohio R. R. Co., other of the numerous roads using this attachment, which has been applied to locomotives in the United States as early as 1862, would doubtless have been attacked. The case was argued by O. E. Edwards, Jr., of New York, for the plaintiff, Tate, and by William A. Redding and J. Snowden Bell, of New York, for the Baltimore & Ohio R. R. Co.

This suit against the Baltimore & Ohio Railroad was of a character well known to railroad men, one that has too often proved a successful form of imposition. A common trick is to secure letters patent on a minor device used upon the rolling stock of some well known railroad, say nothing about it for several years, but ultimately make claims for damages, and ultimately collect, through the reluctance of the company to fight an uncertainty. We consider that the Baltimore & Ohio Railroad Company have performed a positive public duty by pushing this case to a decision.

Imposition upon railroad companies through the pretense of infringing rights on patented devices are more common than the public realize. Among several cases that came within the close notice of the writer was that of Robert Chase, who had risen in railway life to be a locomotive engineer, and then quit to go farming. While following his agricultural pursuits he devised an improvement upon the clevis of a plow. We do not understand what a clevis amounts to, but it performs important functions in keeping a plow turning over the soil. Robert did not patent his invention because he thought it was not worth while. Time went on, and five years after Mr. Chase had invented and put into use his improved plow clevis he received a claim for infringement of the patent on that clevis that had been granted three years previously. Robert naturally got upon his ear and was prepared to defy the claimant. He found it [illegible] who advised him to pay the claim rather than engage in uncertain litigaton. Many other unjust claims have been paid for the same reason, but we congratulate the B. & O. in fighting this one. We understand that our friend, J. Snowden Bell, had great influence in bringing about the decision to fight the case.

High Train Speed.

The information that several electrical locomotives of very high power have lately been put to work performing the railway train operating formerly done by steam locomotives, has led to renewed speculations about future train speed. There is no question about the fact that greater power can be concentrated in an electric locomotive than in one operated by steam, but it does not follow that railroad companies will accelerate the speed of their trains because they have conveniently the power necessary to do so. Within one decade after the locomotive first began hauling regular trains the world was informed that the speed of one hundred miles an hour would be achieved by railway trains in the near future. When years elapsed and the 100-mile an hour velocity was not achieved, people interested put down a mile a minute, or 60 miles an hour, as the common speed of coming railway operating, but even that pace never became common but was attained for short distances on particular trains.

Ever since the steam locomotive was developed to approach to present capacity it has been practicable to run light trains at speeds approximating the mile a minute pace, but that speed has been rarely indulged in. Those familiar with fast train operating are aware that effecting high train speed is expensive to railway companies and that the people enjoying the luxury are not inclined to pay for the extra expense incurred. It may be affirmed without fear of successful contradiction that all the luxury trains run at speeds over fifty mile an hour have been sources of loss to the companies operating them.

About the beginning of the present century an agitation was carried on in Prussia in favor of employing electric locomotives for maintaining high speed on what was known as the Berlin & Zossen Railway. The engines provided were very powerful and met the requirement of hauling an express train for three hours at a speed of 120 kilometers (74.5 miles) an hour. The required performance was achieved day after day for a few weeks, but it destroyed the track so rapidly that the experiment had to be abandoned after a few weeks, and it will not likely be repeated unless some other new substance more durable than steel is discovered and used in railroad construction.

Next Place for Mechanical Conventions.

At the call of the secretaries of the Master Car Builders' and of the American Railway Master Mechanics' Associations, representatives of the two associations met in the secretary's office, in the Karpen Building, Chicago, on November 14, for the purpose of deciding upon the location for next conventions of the associations named. There was a very large attendance of the railway associations and of the railway supply men. Mr. D. R. MacBain was elected chairman of the meeting, after which Mr. O. F. Ostby, representing the railway supply men, intimated to the meeting that representatives from several places were present and wished the privilege of enumerating the attractions of their several locations.

On motion the meeting agreed to listen to the various representatives. One gentleman set forth at considerable length the attractions of Louisville, Ky., and the courtesies the people of that place were prepared to extend to the members of the associations should they decide to meet there. Another gentleman reminded the meeting of the attraction of the favorite meeting place, Atlantic City. After some delay the representative of Chicago interests addressed the meeting. He expatiated upon the attractions, as a place of meeting, of a new pier extending into the lake, but he was not prepared to say that the convention could be held there. It would take six weeks for a decision on this question to be reached. The question of where the next convention should be held was then put to the meeting, and Atlantic City was chosen by a large majority.

Civic Federation Work.

Few people engaged in industrial occupations are aware of the efforts being made to permit the actual producers to share in the profits resulting from their work. The old attitude of capital and labor was for capital to supply the facili- [illegible] profits except the small pittance necessary to keep the operatives alive.

In the last twenty years various benevolent organizations have labored zealously to promote justice between the capitalist and the operator, the Civic Federation having proved itself conspicuous in this [illegible] which includes legal and moral duties of [illegible] [illegible] are interested in the discussion of these questions, and we trust that this interest will be manifested by a large attendance at the meeting. The progress in industrial improvement will be graphically demonstrated in a report giving an analysis of over one hundred profit-sharing plans now in operation in this country, as well as a description of many abandoned ones, and the causes of the failure.

Every person interested in the wellfare of their fellow men ought to attend this meeting.

The Link Motion Eccentric.

One of the most troublesome parts of modern heavy locomotives is the eccentric. When the shifting valve motion, wrongly called the "Stephenson," first came into use, it was put on small locomotives and gave no trouble, but very different conditions prevail with the heavy engines now becoming almost universal. We have had link motion engines running for years without a single complaint being made about eccentrics getting loose, but conditions are very different today. "Loose eccentric" is the burden of reports on heavy locomotives coming in from the road.

When the link motion, which brought the eccentrics, first came into service, it was considered sufficient fastening to secure the eccentric to the driving axle by means of a set-screw. As the power developed, machinists found it necessary to supplement the set-screws by keys, but set-screws and keys are now becoming inefficient. The real crank made practicable with the various forms of radial valve motive is gradually but surely pushing the eccentric into the region of has beens where repose many devices that have outlived their usefulness.

Smoke Making.

Many years ago the writer was a locomotive fireman in a country where the government and public opinion maintained that the emission of black smoke from furnaces or other sources of coal consumption was evidence of carelessness. The opinion of influential authorities guides to a great extent the actions of people subject to their control, and like other firemen the writer acted on the belief that smoke could be prevented by care in firing.

[illegible] of the first novelties that struck him was the careless way that firing was done and the volumes of black smoke constantly seen pouring from the smoke stack. One day he ventured to remark to the fireman, "Don't you think you could get along with less smoke?" and was rewarded with a claimed the fireman, "I never heard of such a thing. Can any one prevent the coal from sending out its smoke?" That was in 1881, and careful inquiries revealed the fact that no engineman on a great trunk line of railway had ever learned that it was possible to burn bituminous coal without sending out clouds of black smoke.

The Grindstone.

In spite of the rapid improvement and consequent changes in the form and methods of using tools the grindstone holds its own with a degree of tenacity that marks it as a mechanical institution. And yet there is little thought given to it. It is perhaps the most misused of tools. Like the Pyramid of Cheops fools come and leave their marks upon it. Of course it can have a new face put upon it, but men may come and men may go, but the abuse goes on forever. To begin with it should be hung on a shaft stiff enough to allow the bearings, or at least one of them, to be removed about two feet from the stone. If the stone is heavy no caps are needed to the boxes, as gravity will hold the stone in place. Water should be brought to the stone through a pipe, and not by a trough beneath the stone which retains all the rubbish which falls from the work while grinding. The pipe should have a valve or cock with an attached nozzle with an opening not more than ¼ in. in diameter. The water should be delivered upon the side of the stone and not on the face, where it will fly off spattering everything within range, while a portion of the face of the stone may remain dry and glazed. When the water is applied to the side of the stone centrifugal force causes the water to flow quickly towards the face of the stone, and if the stone be turned up the least part conical—that is, one edge of the face be made ⅛ in. larger than the other, the water received at the edge having the less diameter, the water will diffuse itself over the face of the stone by the same power which caused the water to travel from the side to the face of the stone.

The bearing close to the stone should be made of phosphor bronze, or some composition that water will lubricate. A loose cover will keep the dirt from it. Soft spots in a stone should have a little cold tallow rubbed on the spots and it will prevent them from wearing away, and the stone will be kept true. Where there is no truing device the best tool to use in truing [illegible] A piece of pipe never gets dull like a solid piece of iron. The section is always narrow, and by constantly rotating the pipe, a clean new surface is presented to the stone, which is cut away very fast. Give the grindstone an occasional thought and the result will be manifested in a marked improvement in cleaner and better service.

Locomotive Running Repairs

By JAMES KENNEDY

IV—Treatment of Impurities in Water

It is a noteworthy circumstance that new boilers have a greater tendency to "priming" than boilers that have been some time in use. Clean water and a clean boiler are the best preventatives. Water absolutely free from foreign admixture is not to be found. Even rain water before it has reached the ground is not free from impurities. Gases, dust and other light matter mix with the falling rain. As the water passes through or over the earth many foreign substances are added to it, and it seems as if these impurities increased in volume when the water is converted into steam.

In the case of new or newly repaired boilers it is safe to assume that there is a quantity of oil or other foreign matter in the boiler, and that priming may be expected for a few days at the first trials of the engine. The theory in regard to priming is that when steam bubbles form by the action of heat they rise to the surface of the water. The oil or soapy matter floating on the surface of the water forms a shell or covering for the steam bubbles as they break through the water. These bubbles accumulate and form into clusters as foam on turbulent rivers. It seems incredible that bubbles could exist with high steam pressures acting upon them, but the rush of steam to the thottle valve carries the bubbles intact, and they are broken in their passage to the cylinders, and appear as water in the exhaust.

This priming or foaming should be distinguished from high water in the boiler. Many young engineers have a tendency to allow too much water in the boiler. This overanxiety on the side of safety, as far as avoiding the scorching of the crown sheet is concerned, has a pernicious effect on the working of the engine. The excessive amount of water in the boiler lends itself readily to the mixture of water and steam, and the saturated or water-laden steam affects the valves, especially the valves of the piston variety, often causing a collapsing of the rings. The bursting of cylinder heads is not uncommon by this cause, as the water confined in the steam passages by the action of the piston if not relieved at the valve openings may fracture the cylinder.

While the impurities incident to water and the over supply of water to the boiler may not be entirely avoidable, there are now many devices in operation for purifying water. It is known that distilled water will not prime. The various water treating plants used by many railways for removing or minimizing the effect of foreign substances in the water has shown [illegible] and while there has been much mystery concerning the make-up of those compounds, their general basis is soda, and some of the other ingredients are extracts of tannic substances, some of them containing starch or gelatinous matter, which is calculated to have the effect of coating the inner surface of the boiler with a kind of mucilaginous covering, thereby helping to prevent the mineral particles floating on the water from adhering to the boiler shell. Some of these compounds are fairly effective, the foreign substances in the water being largely kept in a muddy solution, which can be easily blown out.

Water containing lime has a great tendency to form a hard scale on the boiler, and carbonate of soda has the effect of reducing the lime to the form of a soft solution. Caustic soda is also much used where the compound is fed into the feed tank. The tannic compounds that are used in boiler compositions are extracted from oak, chestnut, logwood and other timbers which contain tannin. The amounts used of these compounds vary according to the amount and kind of substances that may be in the water. The greater the amount of lime in the water, the greater is the tendency of scale forming and adhering to the plates and flues. This scale, which is largely carbonate of lime, adheres with great firmness to the metal, and forms a combination with the oxide of iron or rust, and it is expressly desirable that in washing boilers the boiler should not be emptied and allowed to dry, as in this case the atmosphere has the effect of aiding in the formation of a hard crystalline scale.

It is good practice in the first days of an engine's working to blow out the boiler while under steam pressure, and at the same time admit cooler water, not allowing the boiler to dry. The steam pressure will greatly aid in cleaning out oil or other impurities that may have given rise to priming, and the boiler should not be cooled too quickly. If scale is once formed and allowed to accumulate, it becomes very difficult of removal. In locomotive practice it is frequently noted that locomotives that run consider- [illegible] the road on which they travel, are much more easily cleaned than locomotives that are constantly supplied with one kind of water. This arises from the fact that scale that has been formed by lime deposits, may be removed by deposits from water containing sand-stone deposits. The [illegible] ble effect on the hard limestone scale.

It need hardly be added that the use of strong acids in a boiler requires that the experiment be carried out under the most intelligent supervision. The free use of sulphuric and other acids may have the effect of attacking the plates, and so lead to a rapid deterioration of the boiler, but it is safe to assume that the plates will not be seriously attacked as long as there are any scale formations on which the acid can exert its energies. As we have already stated, the cleaning and softening of water is a matter on which specific rules could not be given unless some particular water was taken as an illustration. As a rule, water from wells contains more impurities of an injurious kind to boilers than water from lakes or rivers. The self-cleansing quality of water is well known. The river Rhone is a good illustration. It is said to contain more impurities than the Wabash or Ohio rivers before it reaches the Lake of Geneva. When the Rhone reforms at the other end of the lake the water has become clarified. The lesson to be learned from this fact is of real value where there is an opportunity of forming a deep reservoir where the mineral impurities in water may have an opportunity of settling to the bottom of the reservoir, and leave the upper waters comparatively pure. In treating water with a view to reduce the impurities a sample of the water should be analyzed, and it is safer to be guided by experience than to follow haphazard methods.

Iron and Steel Production.

The prophecies of the ironmasters of the generation are coming true. Twenty years ago predictions were made that there would be an annual output of 40,-000,000 tons of pig iron and 50,000,000 tons of crude steel within 25 years. To-day the country is producing pig metal at the rate of 37,500,000 tons a year and the output of steel ingots is approximately the same. Before many months production will reach 40,000,000 tons annually, but it would require 12 months of sustained prosperity, like the present, to make possible the production of 40,-000,000 tons of either iron or steel in a [illegible]

Protecting Iron or Steel.

Holding an iron or steel article in a [illegible] four ounces of [illegible] acid and an [illegible]

2-6-0 Mogul Type of Locomotive for General Switching Service on the Newburgh and South Shore Railway

suitable design

motive, recently built by the Baldwin Locomotive

switching service in the cities of Cleveland and Newburgh, Ohio. The new lo-

ladle over a line having grades of 52

the improved Rushton pattern with drift

relief are applied to the locomotive, the

The steam distribution is controlled by 12 inch piston valves, which are driven

are connected to the rear driving wheels.

heets, sides 5/16 in., back 5/16 in., crown in., tube, ½ in.

Tubes Material, steel, diameter, 5½

ins. 36, 2 ins. 241; length, 12 ft.; firebox, 165 sq. ft.; tubes, 2,066 sq. ft.; firebrick tubes, 25 sq. ft.; total 2,256 sq. ft., grate

ins., center 44 ins.; journals, 10x12 ins.

Engine Truck Wheels Diameter, 30 ins., journals, 6x10 ins.

Wheel Base Driving, 11 ft. 6 ins.; rigid, 11 ft. 6 ins.; total engine, 20 ft.; total engine and tender, 50 ft. 5½ ins.

Weight On driving wheels, 163,800

with a comparatively short rigid wheel

pair of driving wheels. The driving tire

Tender Wheels, number 8, diameter

crown sheets. Upper tail ends of the ate

Boiler Type, straight, diameter, 80

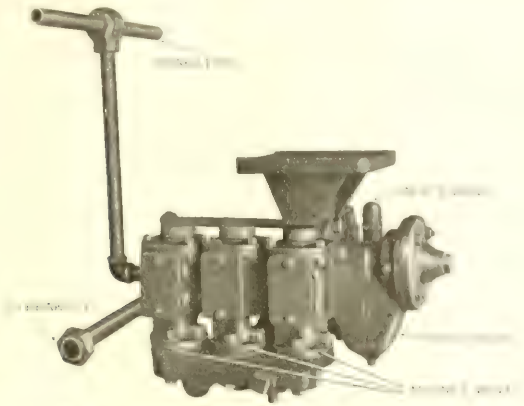
Glue

to the consistency of a jelly. This glue

Air Brake Department

New York Air Brake Company's P. S. Electro-Pneumatic Brake Designed to Meet Modern High-Speed Traffic Requirements

In [illegible] our readers that the New York Air Brake Company had developed an electro-pneumatic brake for steam road service and that at the first opportunity a descrip-



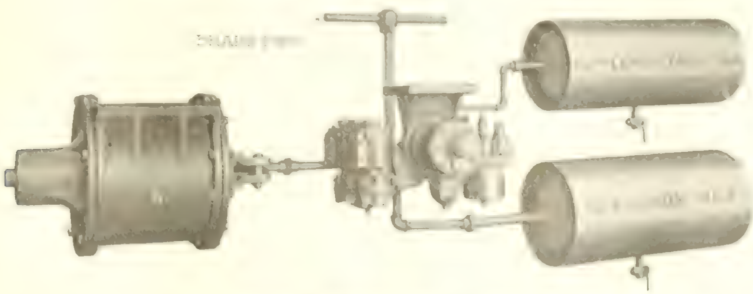
[illegible]

tion of it would be given in these columns. At the present time three photographic views of the exterior of the passenger car equipment are available, this is known as the type PS, and is designed to meet modern high-speed traffic requirements.

From previous references to electro-pneumatic brakes our readers will understand that the retarding force of the brake is secured by means of compressed air and that the electric current is used to produce uniform braking effect and simultaneous action throughout the train for service operation and instantaneous action for emergency stops. With this installation, the brake cylinder, auxiliary and supplementary reservoirs remain the same as with standard pneumatic equipment, the changes being made by additions to the operating mechanism. A triple valve, vent valve and electro magnet portion are mounted on a bracket from which any portion can be separately removed without breaking any pipe connections and the apparatus may be operated either pneumatically or electrically. When operated pneumatically, the triple valve controls the flow of compressed air to and from the brake cylinder and reservoirs, and its movement is actuated

[illegible] the vent valve, the service and emergency [illegible] other so that an emergency application [illegible] sure in the different sized brake cylinders being accomplished through the use [illegible] triple valve.

The electric portion consists principally of magnets which when energized and de-energized, operate air valves known as magnet valves, two of which are used to [illegible] the atmosphere for making the brake pipe reduction necessary to apply the brake in service or emergency, and one is used to control the exhaust of compressed air from the brake cylinder during the release of brakes. The operation of the electro magnets involves a wiring system throughout the train, jumper connections being used between the cars and the contacts are made at the brake valve on the locomotive and these contacts for energizing and de-energizing the magnets are so arranged that the electric and pneumatic features are interlocked, that is, the movements of the brake valve are the [illegible]



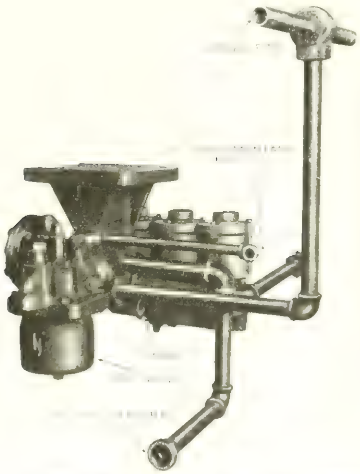
[illegible]

[illegible] to service position, the service magnets are instantly energized and move the [illegible] rate of reduction in the brake pipe pres-

[illegible] piston will discharge the brake pipe pressure to the atmosphere instead of the escape of air taking place at the electric portion of the operating valves on the cars.

The same is true in the emergency position of the brake valve and in release or holding position, the release magnet is energized and the escape of brake cylinder pressure prevented, so that the brake may be graduated off as desired. With these equipments the pressure in the brake cylinders on all of the cars in the train may be varied up or down at will.

The principal features of this brake are, a quick recharge of the auxiliary reservoir which makes it possible to obtain full braking power immediately after a release of brakes has been made, and permits of as many applications and releases in quick succession as may be de-



sirable without materially depleting the system.

A pneumatic quick service feature is incorporated wherein each triple valve mov- [illegible] brake pipe reduction, this serial brake pipe [illegible] chamber or measuring chamber which in- [illegible] valve which opens the brake pipe pressure to the atmosphere and is entirely independent of the operation of the triple [illegible] less of any triple valve action that may [illegible] ency stops is obtained as well as the quick recharge of the auxiliary reservoir. The high emergency brake cylinder pressure is maintained without blow down throughout the stop, but for service operation the brake cylinder pressure is limited to a predetermined amount.

The action of the electric emergency application is simultaneous throughout the train, all triple valves and all vent valves operating at the same time, but an inoperative vent valve would not prevent the application of the brake or triple valve on that particular car or one inoperative would not destroy the emergency action of the brake. In a future issue we hope to have diagrammatic views of the interior of the mechanism from which the construction and operation of the valves will be explained.

Handling Defective E. T. Equipment.

In commenting upon this subject, we believe that it is advisable to make a distinction between handling defective equipment and what to do in the event of broken air pipes with the E. T. brake equipment, not that it is impossible to handle both subjects at the same time, but by separating them there will be less opportunity for confusion.

Whatever may be said concerning the handling of brakes with defective equipment on the locomotive, will have reference to a time when the locomotive is out on the road and there is no opportunity for making the proper repairs.

It will be understood that it is against the law to run a locomotive either in road or yard service with an inoperative driver brake, but it has been explained to mean that an engine must not be dispatched or leave a terminal in such a condition, however if through an accident or some unforseen occurrence, the driver brake becomes inoperative enroute, it is permissible to move a train to another point where correct repairs can be made or where another engine can be secured, provided that the conditions are such that the train can be safely handled without the use of a driver brake.

Under similar conditions it will be possible to proceed with a train having what may be termed an emergency brake, to a point where the proper repairs can be made or where another engine can be secured, provided of course that the proper precautions are observed and that no risk of accident or damage to equipment is incurred. With this in mind we will outline a system of temporary repair methods and make an effort to explain how the equipment of the locomotive may be affected by certain disorders and how they may be readily located and temporarily repaired.

It will also be understood that many of the effects of brake manipulation that indicate a defect of the locomotive brake are really to be expected results, or in other words, the so-called defects are very frequently imaginary. As an example, in coupling to a train of uncharged or partially uncharged cars, the compressors may stop when the brake valve is moved to running position and this may be considered a defect of some part of the locomotive brake apparatus whereas this is a natural effect of holding the brake valve in the wrong position for charging a train. Again it may be observed that after an over-reduction of brake pipe pressure is made with the brake valve, a release sometimes results in a re-application of the brake which is also to be expected if the distributing valve is in perfect condition as the re-application is due to the over-reduction in brake pipe pressure and not a disorder of the distributing valve.

In the event of a broken down compressor, the engineer is not expected to make any repairs along the road and especially not with the Cross Compound and Duplex Compressors and even if the necessary tools are available and the engineer happens to be competent to make the repairs, with some installations it is necessary to remove the compressor from the locomotive before the top head can be removed, and certainly the main line of a modern railroad is no place for air pump repair work.

This trouble, however, must not be imaginary and result in cutting off the engine when there is really nothing wrong with the pump except a governor defect or a lack of lubrication, therefore, when a pump or compressor fails to operate it must be known that the steam portion is receiving the necessary amount of lubrication and that a sufficient quantity of steam is entering the steam cylinder and that the exhaust pipe is not obstructed. There is very little opportunity for an obstructed exhaust pipe to stop a compressor along the road unless certain outside connections have been made in the exhaust pipe for train heating or other purposes but the pump governor may cut off the flow of steam to the pump at any time and with a closed or stopped up relief port in the neck of the governor its action is not so apparent, and for this reason it is good policy to partly unscrew the union pipe connection between the compressor and governor in order to be absolutely certain that sufficient steam is entering the steam cylinder to run the pump.

If the compressor stops due to the diaphragm portion of the governor top remaining open, that is, with the diaphragm valve off its seat, the top can be unscrewed from the steam portion and again connected with the pipe to prevent a leak and the compressor can be controlled with the pump throttle, but as we are dealing with the standard E. T. equipment, the correct practice would be to merely disconnect the pipe and put a blind gasket in the governor pipe so that the operation of

the excess pressure top will [illegible] in the first three positions of the brake valve.

If the steam valve portion fails to open, it may sometimes be opened by tapping the under side of the governor with a hammer, but if it persists in sticking shut and preventing steam from flowing to the compressor, the two portions can be disconnected, and the pipes again coupled up and the speed of the compressor governed with the throttle. The failure of an air gage, that is, the breaking of some of the inner tubing or a hand coming off or working loose, is not a serious matter for with this equipment there are two gages and it is possible to make fairly accurate stops without observing the air gage once several stops have been made with the train.

If the brake pipe feed valve becomes inoperative, it is possible to handle a train without any delay provided that the pump governor is reasonably sensitive to respond to a main reservoir reduction. If the feed valve sticks open and main reservoir pressure enters the brake pipe, the amount that enters the brake pipe or rather the pressure that enters it can be regulated with the pump governor, and if the feed valve sticks shut, the brake valve handle can be moved to a position between release and running which will supply the brake pipe leakage and at the same time maintain pressure in the feed valve pipe so that the excess pressure governor top will not prevent the operation of the air compressor.

Should the reducing valve stick shut, the independent brake and the signal whistle is destroyed, and if it sticks open as it frequently does, main reservoir pressure enters the signal system with some undesirable results, but the safety valve of the distributing valve limits the amount of pressure that enters the brake cylinders during an independent application.

If the independent brake valve becomes inoperative from the rotary valve being off its seat, so that the brake on the engine remains applied, it is only necessary to unscrew the adjusting nut of the reducing valve to cut the pressure off from the independent valve and proceed without an independent brake or signal whistle.

If the distributing valve becomes defective enroute, the stop cock in the supply pipe may be closed to prevent its operation, but if the valve has a quick action cylinder cap, and the emergency slide valve remains open, it may be necessary to disconnect the brake pipe and place a blind gasket in the brake pipe branch if there is no cut out cock in this pipe. This also applies to cases where quick action develops enroute and can be traced to the distributing valve of the locomotive and for this reason a stop cock should be used in the brake pipe branch of the distributing valve when the valve is equipped with a quick action cylinder cap. It will occur to the reader that as there are only two pipes connected with the distributing valve that contain air pressure when the brakes are released it would only be necessary to plug the main reservoir supply pipe and the brake pipe branch and proceed under any imaginable condition even if the entire valve and reservoir were lost off the engine.

If the equalizing piston of the brake valve were to stick shut, the engineer would almost unconsciously move the valve handle to direct application position to make the necessary brake pipe reduction and if the equalizing piston was to stick open, the brake pipe exhaust port can be plugged after the valve handle is placed on lap position and the cut-out cock under the brake valve is closed then the brake valve may be handled as though the equalizing piston was stuck shut.

If the upper portion of the automatic brake valve becomes disabled in such a manner that the air pressure must be cut off from it, it is almost necessary to call for another engine, however, if there is but a short distance left to cover before reaching a terminal or a place where repairs can be made, an emergency brake can be created by using the independent valve and crossing over the couplings between the engine and tender or between the tender and the first car as outlined in the previous article on "broken air pipes," when the brake pipe is broken off under the automatic brake valve, only where it is necessary to cut the air away from the automatic brake valve it can be done by closing the reservoir cock and placing a blind gasket in the main reservoir pipe near the automatic brake valve.

When a brake cylinder is broken, a gasket blown out or the brake rigging broken, the stop cock in the pipe leading to that particular cylinder can be closed to prevent a waste of air or an application of the brake, and while some of the other disorders mentioned might occur but once in a lifetime, knowing what to do in a case of emergency naturally leads to a better and more thorough understanding of the air brake and in all cases of investigating the causes of air brake failures, someone has had ample time in which to decide just what should have been done to bring the detention down to the lowest possible figure.

We have intentionally neglected the operation of the excess pressure governor top for a later consideration in connection with "brake valve manipulation," but before commenting upon this matter it might be well to state that most of these emergency cases result from a lack of proper air brake inspection, and while the [illegible] condition of the brake before the engine leaves the engine house, the engineer should also make an inspection not exactly as a check on the inspectors' work, but to avoid so far as possible the chances [illegible] neglect [illegible] and that the governor and feed valve are sufficiently sensitive to maintain them, that the brake cylinder piston travel is correct and that there is no noticeable leakage in the brake system. Excessive brake cylinder leakage may cause a heavy drain on the main reservoir at a time when all of the main reservoir capacity may be needed for a release and recharge of train brakes and with excessive brake cylinder piston travel it may become necessary to make the quickest possible release of the engine brake as in the event of wheel sliding, and the longer the piston travel, the longer the time required to exhaust the pressure from the brake cylinders.

A feed valve should be tested for sensitiveness by making a 2 or $2\frac{1}{2}$-pound reduction of brake pipe pressure and being sure that the valve opens promptly and returns the gage hand to the original figure of adjustment. Then by making a 5-pound brake pipe reduction to see that this will operate the distributing valve, and following with a full 20-pound application to see that 50 pounds is obtained in the brake cylinders with a release made with the independent brake valve will give a fair indication of the condition of the brake. It is also well to observe that 45 pounds is maintained by the reducing valve and that the independent brake can be graduated off in about 5-pound steps. This is of considerable importance because a release of the independent brake will insure that the application cylinder and release pipes are not crossed and that the brake can be released under any conditions and the graduating of brake cylinder pressure will indicate that the application piston of the distributing valve is sensitive enough to prevent a number of light applications building up a pressure in the brake cylinders that might be sufficient to overheat and loosen driving wheel tires through the defective application portion, retaining a certain amount of pressure in the driving [illegible] brake valve handles may be in running position.

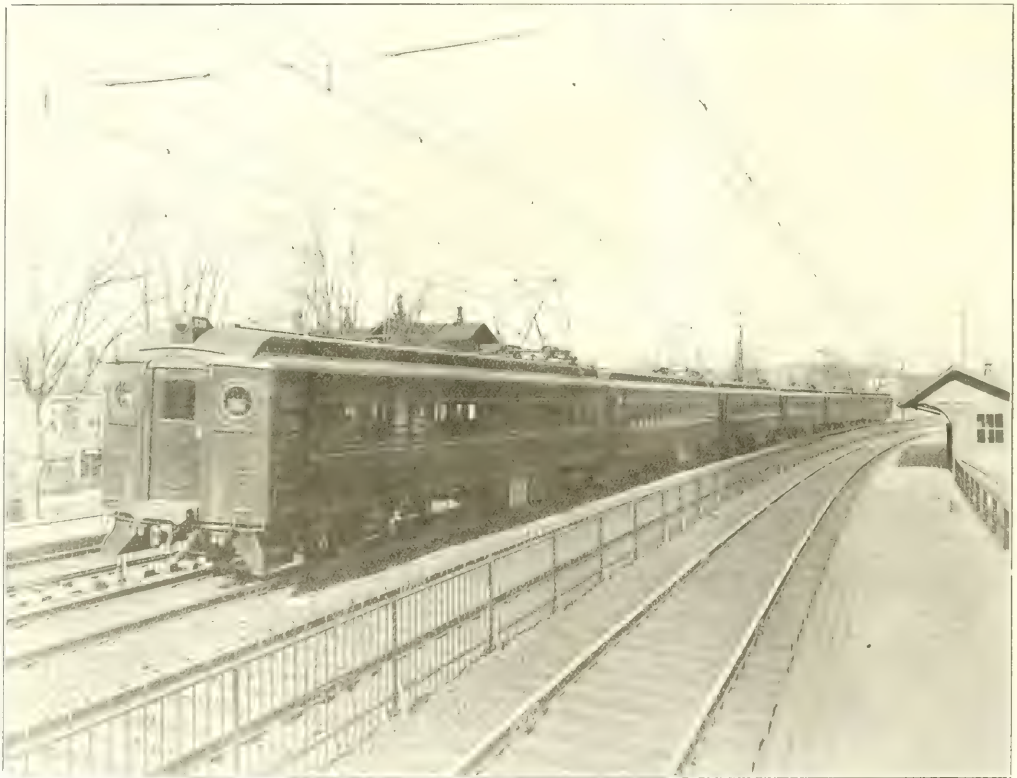
In the event of a loosened driving wheel tire caused by a sticky application portion of a distributing valve, an instructor would likely take the stand that an engineer should know before leaving with an en- [illegible] a time or less and in such cases the application portion will not be sticky enough [illegible] cause such a failure of the brakes to release.

Electrical Department

Important Addition to the Suburban Electrification of the Pennsylvania Railroad Between the Broad Street Station, Philadelphia and Paoli, Pa.

[illegible] pleted on the Pennsylvania railroad between Broad Street station, Philadelphia, and Paoli. The work embraces the electrification of about 20 route miles, with about 93 miles of track. The system is what is known as the overhead catenary trolley system; the power is supplied direction between the power house and the sub-station consisting of [illegible] submarine cables under the river.

From the sub-station there are four 44,000-volt single phase transmission lines. Two lead into the West Philadelphia sub-station, and two of them continue on to the Paoli sub-stations. The transmission lines are carried on brackets [illegible] electric service without structural changes. This was made possible by the fact that the requirements for mounting electric apparatus on the cars had been thoroughly considered at the time when the steel car was introduced on the railroad. There are 93 of these standard all-steel cars in the service, 82 of which are passenger cars, 9 are combined pas-



[illegible]

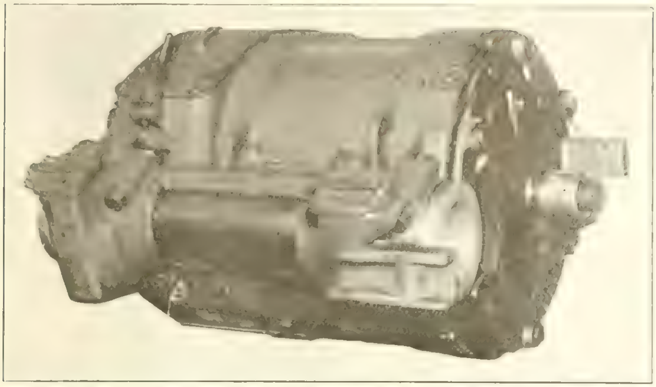
[illegible] power station of the Philadelphia Electric [illegible] on the easterly bank of the Schuylkill [illegible]

[illegible] this point the lines are carried on the [illegible] sides of the tracks.

[illegible]

[illegible] no trailers will be operated in the service. [illegible] of two 225 h.p. single phase, air blast- [illegible]

brake equipment. The main electric apparatus is mounted on one end of the [illegible]



TYPE OF MOTOR USED ON THE PENNSYLVANIA RAILROAD [illegible] PHILADELPHIA AND PAOLI, PA.

car, and the air brake equipment is mounted at the other end. This gives an uneven weight distribution on the two trucks, with the result that about 60 per cent. of the total car weight is on the driving wheels.

Each car is equipped complete with two motors, having a 24-tooth pinion and 55-tooth flexible gear; and each has an hourly rating of 225 h.p., and a continuous rating of 200 h.p. when ventilated with 1,200 cubic feet of air per minute. The flexible gear is made up of a rim, on which the teeth are cut, a center, a cover plate and spring details. The rim is spring mounted on the center, the periphery of the center and the cover plate acting as the bearing surfaces for the rim.

The fan for ventilating the transformer and motor is a 21-in. single inlet Sirocco wheel, and is mounted on the shaft of the motor which drives the compressor. The motor drives the fan continuously, and the pinion driving the compressor is connected to the motor by a disc clutch. The motor is of the doubly fed type, and operates at approximately 980 revolutions per minute, at normal voltage, with the continual loads of the fan and compressor, while the speed with the fan alone approaches 1,300 revolutions per minute.

The motorman's brake valve contains both electric contacts and pneumatic parts, the electric portions being mounted above the pneumatic portions. There are [illegible] the electric holding; the handle off; lap, service; and emergency. The first named position is to the left, and in this position all train brakes are released and the system charged. The electric holding position holds the train brakes through the electric control system, but recharges the system. All ports are closed in the

[illegible] tion.

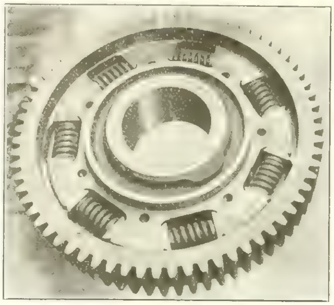
[illegible] divisions, about 15 route miles, all four track, the old form of semaphore signal [illegible] dicate the various positions of clear caution and danger. Normally one 150 [illegible] all the signal power, and this set is relayed by the second set at West Philadelphia, and by the 75 kva. set at Paoli [illegible] tions are entirely separate from the electric traction system, thus insuring a supply of signal power at all times.

Throughout the electrified zone the telegraph and telephone wires are placed underground. Along the main line the underground conduit consists of six single conduits, 3-in. bore, part in clay

emergency positi ns [illegible] protected with con-

[illegible] the [illegible] director and the train dispatchers, there are permanent telephone boxes located at every signal bridge, about half a mile apart, throughout the electrified zone, and prompt, reliable intercommunication by [illegible] of the whole system.

There are many other novel and ingenious devices and mechanical applica- [illegible] out in advance, and the service rendered will relieve the congestion of suburban traffic which has taxed the limit of capacity in the locality, and there is every indication that the relief will be maintained for many years to come. The electrification of other suburban lines will soon follow should the trial of this initial electric service meet expectations.



TYPE OF [illegible] TOOTH FLEXIBLE GEAR USED ON ELECTRIC MOTORS

[illegible]

[illegible] Gibbs and Hill, consulting electrical en- [illegible] for the company, in co-operation with the engineering department and the officials of the railwa[illegible] The mounting of the car equipment was carried out by the [illegible] graph and telephone lines were designed and installed under the direction of the signal and telegraph departments.

The Westinghouse Electric & Manufacturing Company furnished the motor car, switching, transformers and other of the main portions of the equipment. The block and automatic signal equipment was furnished by the Union Switch & Signal Company, and it may be briefly stated that the material from these and other leading firms was all of the best, so that the work may fairly be said to represent the most advanced of its kind hitherto established in railroad transportation.

The Best Way to Learn All About a Thing.

We have been consulted frequently concerning the beest methods of acquiring information on any subject. One time that a question came to our mind relating to an engineering subject, we felt sufficiently familiar with the question to determine to write a book about it. It was only when we began writing the book that we realized how dense was our ignorance of the subject that we were prepared to explain to the world at large. We were very much discouraged when the extent of our ignorance became manifest, but happily we determined to persevere and proceeded to study the lines where our ignorance was most dense. By degrees knowledge took the place of ignorance, and when the book was finished it proved a success. The lesson of that experience reads: "When you want to learn all there is on any subject, write a book about it."

An Appalling Possibility.

Broadway is laughing over a story about a wine agent and an eminent actor whom the other had attempted to make use of as an advertising medium. The agent is introducing a new brand of champagne, and the other day he induced the actor to assist him in the consumption of a pint bottle of it at one of the fashionable restaurants.

"And now I'll tell you how you can do me a good turn—if you should happen to feel like it," he said.

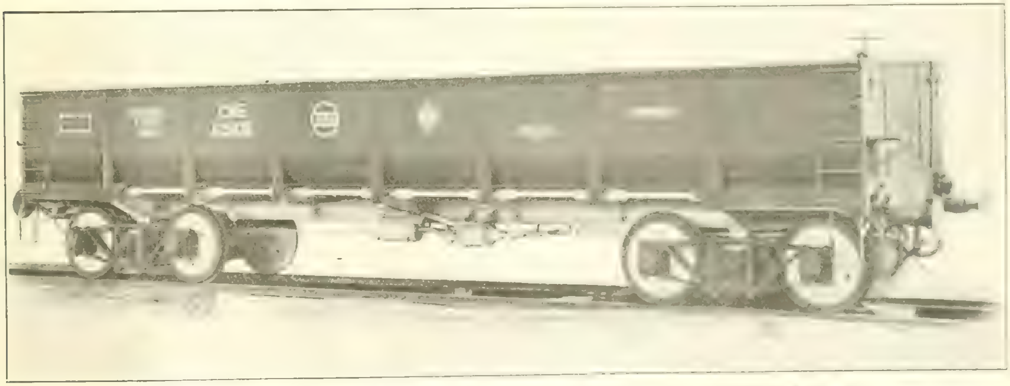
"Delighted to do you a good turn, of course," responded the actor.

"It's this way," the agent explained. "You are traveling about the country a great deal and stopping at the best hotels. Now, I want this champagne to become known in order to create a demand for it. What I would like you to do is to ask for my wine by name at the hotels you go to, so that the hotel men will get the idea that it is popular in New York and send in their orders for it. You won't mind doing that for me, will you?"

"I'll ask for it with pleasure," the actor declared. "But, good heavens, man!" he [illegible] Suppose they should have it!"

Extensive Equipment of Steel Gondola Cars for the Imperial Russian Government Railways

Among the details [illegible] increase in the manufacture of railway rolling stock induced by the European war, it is interesting to observe the special points of difference between the designs obtaining in this country and that of the countries to which the goods are consigned. As an illustration the car equipment orders recently placed in this country by the Russian Imperial government include a lot of 5,000 steel general service gondola cars, which are now being built at the McKees Rocks plant of the Pressed Steel Car Company. This type of car was designed by the builders, and differs particularly in the couplings and buffers, which are of the Russian standard, but otherwise closely resemble one of our own most popular types. The rated carrying capacity is 50 metric tons, about 110,000 lbs., and the light weight about



[illegible] Pa., Builders.

46,000 lbs. One of the requirements of the specifications was that the car must stand a test load of 75 metric tons uniformly distributed without permanent set, and the completed car was so tested with results entirely satisfactory.

The bodies are 40 ft. long x 9 ft. 6¾ ins. wide x 4 ft. 4 ins. high inside, and have doors on both sides throughout the length, making same about 99 per cent. self-clearing when loaded with coal or similar material. The doors are operated by the Pressed Steel Car Company's creeping shaft device, and rest directly on the shafts when in the closed position. With this device the chains, which wind on drums, are only employed for lifting the doors and to hold the shaft in place under them when in the closed position, as stops are provided to engage both sides of the doors when they are dropped, thus eliminating the shock which would otherwise have to be absorbed in the chains when load is dumped. The ends are made of 2¼-in. planks, reinforced all around [illegible] bolted to planks, and are secured with links at the end sill in such a manner that they can be dropped into the car when not required, thus making the car more suitable for the transportation of long materials.

The center sill construction is continuous from end sill to end sill, consisting of two 5/16 in. bent plates riveted to a 4-in. rolled tee at the top, and each reinforced at the bottom with a 3½-in. x 3½-in. angle. Malleable iron center braces are provided at the bolsters, and pressed steel braces at the cross ties. The end sills are ⅜ in. pressed steel, reinforced with pressed channels extending between short side sills and center sills, and connected to same, and are braced from points at the rear of the buffers, with pressed channel shaped braces in such a manner that the major portion of the buffing shock will be transmitted through these braces into the center sills. The bolsters and cross ties are pressed dia [illegible] plates in three lengths, supported by seven pressed steel side stakes located at bolsters and cross ties, and are reinforced at the top with 4-in. rolled steel bulb angles extending full length. Near the bottom the side sheets are [illegible] a flange turned out which rests on the end sills, bolsters and cross ties, and [illegible]

[illegible] up tightly against same.

[illegible] teen, eight located on each side of the center, are made of ¼-in. steel, flanged [illegible] forged hinge straps, which are pin-connected to malleable iron hinge butts and riveted to center sills. Besides the hinge straps two stiffeners of 2½-in. x 2½-in. x 3/16 in. angle extending crosswise of car, and one 3-in. rolled Z bar located near the outside, and extending lengthwise of the car, are provided on each door. The door stops are located to secure a discharge opening about 2 ft. deep between the trucks, but, due to the large wheels involved, the door openings over the trucks are somewhat less.

The Russian type of Westinghouse air brake equipment, with 10-in. cylinder, is being applied, and while it differs quite a little in detail from the Westinghouse freight car equipment used in this country, it is very similar in general. The [illegible] the line of the standard practice in this [illegible] brake shoes [illegible] link type, and the buffers are the Rus- [illegible] have been substituted in place of the volute springs used by them in the past [illegible] lbs. per square inch for others. A test

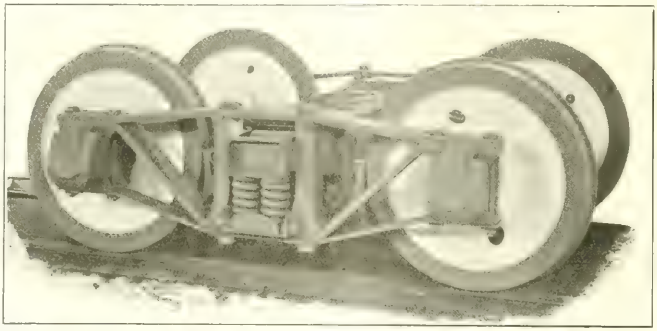
...to ... then ... plied to the finished coupling, which it must stand without permanent set. The buffer stems are required to be forged without a weld, and the manufacture of this item, as well as that of the couplings, involves some very interesting forging operations.

The trucks are of the arch bar type, having 6 ft. 3 ins. wheel base, and follow the lines of the standard M. C. B. construction, though somewhat larger, due to the use of 41 5/16 in. diameter wheels, and to adapting them to the Russian standard gauge, which is 60 ins. They are being equipped with pressed steel bath tub type bolsters, having cast steel center plates ... M. C. B. ... ble malleable iron side bearings. Other equipment includes M. C. B. malleable iron journal boxes, drop forged wedges, class "D" springs, and cast iron brake shoes. The brake beams are similar to the M. C. B. No. 2 ... modified to suit the gauge, and are suspended from brackets cast integral with column posts by "U" shaped hangers. The arch bars are 6-in. x 1 ... and the tie bars 5-in. x 5/8-in. These are secured to cast steel column posts with 1 3/4-in. bolts, and to journal boxes with 1 1/4-in. bolts. The spring planks are 13-in. 32-lb. rolled channel, and are bolted to column posts with 1-in. bolts. Into these at each end is ... malleable iron ... seat having guard fits the same as the standard M. C. B. axle for 100,000 lbs. capacity cars, and, except for the increase in length over the M. C. B. axle necessary to suit the gauge, the most important difference is in the wheel fit, which differs from the M. C. B. in that in place of the collar back of the wheel hub, the diameter of the axle is reduced to less than the diameter of the wheel fit at this point; in fact this reduction in diameter begins about 1/4 in. under the wheel hub.

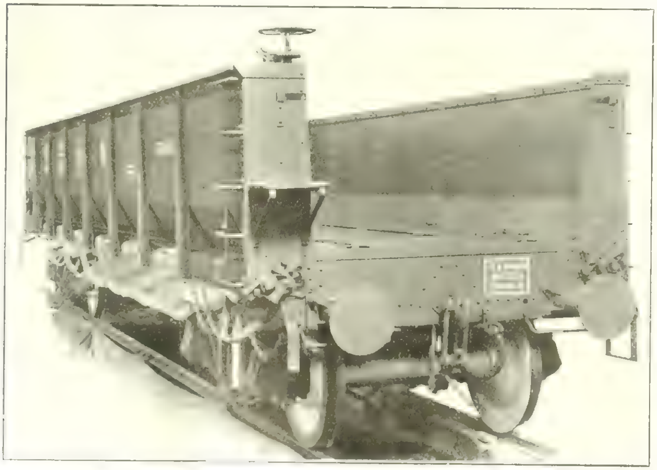
The completed car stands 8 ft. 11 ins. from rail to top of sides, is 44 ft. 4 1/8 ins. long over the buffers, and presents a substantial and clean cut appearance. Every detail seems to have been given very careful attention, and this car should give a very creditable account of itself in service.

Aside from the cars themselves, their delivery is very interesting in that they practically circle the earth before they reach their final destination. The cars are ... New York, where they are loaded into ... and start on their long voyage to Vladivostok via Panama Canal. At Vladivostok they will be assembled and make the rest of the journey on their own wheels.

The trucks are shipped built-up complete, and the underframes are also assembled complete with the end sills, cross ties, bolsters, short side sills, door stops and braces riveted, and the doors, shafts, chains, and other parts of the door operating device in position. The sides are also riveted up complete, and two sides are secured together to form one package. The end gates are packed in a similar manner, and the smaller parts are packed into boxes, each box in most cases containing materials in complete sets for five cars.



TYPE OF TRUCK USED ON THE FREIGHT CARS FOR THE IMPERIAL RUSSIAN ... RAILWAYS



... IMPERIAL RUSSIAN GOVERNMENT RAILWAY

... the truck at this point. The wheels are rolled steel, with flange and tread similar to the Russian standard, but differing only slightly from the M. C. B. These are being manufactured by the Carnegie Steel Company to their specification, and weigh nearly 1,200 lbs. each. The axles are of steel, having journals, collars and ...

Railways of Southern India.

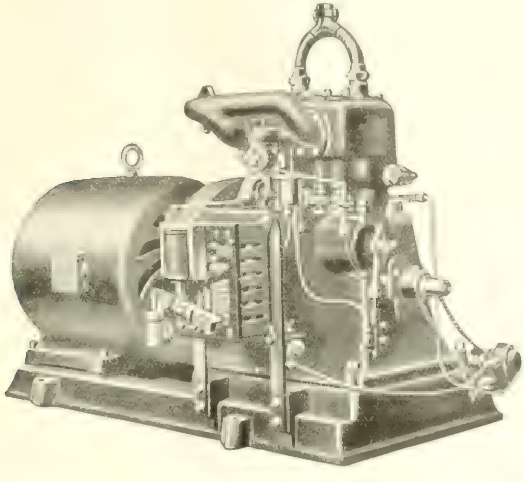
The effects of the war were seriously felt by the railways throughout southern India in 1914-15. These comprise the three great systems—the Madras and Southern Mahratta, the South Indian, and the Nizam's Guaranteed State Railway. The total trackage of the three systems referred to was 5,684 miles ... represented an extension of ... miles during the year. On the same date the total number of persons in the employ of the railways was 78,300, or ...0 less than at the close of the preceding year.

Contracts have been let by the Baltimore & Ohio railroad for 62,500 tons of rails for immediate delivery. The orders were placed with the Maryland Steel Company, Cambria Steel Company, Carnegie Steel Company and the Illinois Steel Company. Practically all of the rail will be used for replacement in the company's main lines, being of heavy type, weighing 100 pounds to the yard. The order supplements contracts let by the Baltimore and Ohio during the summer for equipment and rails which cost approximately $3,500,000.

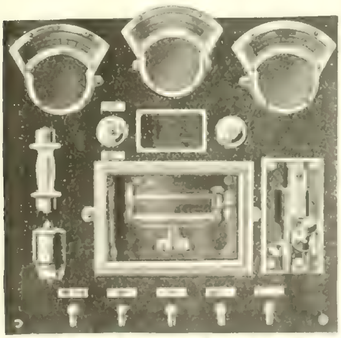
Bruston Electric System of Lighting

Admirably Adapted for Smaller Stations and Roundhouses

The marked success of the Brushton Electric Systems of lighting has sprung rapidly into popular favor and already over 1,000 installations have been made, and in not a single instance has it been replaced by another plant or complained of as unsatisfactory. It seems admirably adapted to that vast variety of locations where a large power system is not necessary or available, and possesses the double merit of the lowest cost and perfect automatic action, requiring no expert attention whatever, and is undoubtedly the result of a thorough study of the needs of the locations that we have referred to.



ENGINE AND GENERATOR



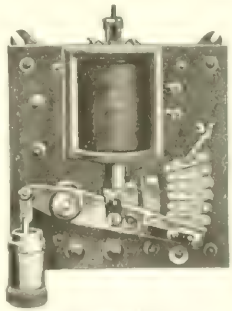
SWITCHBOARD

The system consists of an engine and generator on a base, a switchboard, and a small battery. A gasoline engine is specially made for the work and together with the generator may be placed on an ordinary floor requiring no foundation or fastening. The switchboard can be understood at a glance, and the small storage battery may be mounted in a small rack near the engine. The apparatus is so constructed that by simply turning on a few lamps the storage battery supplies a sufficient current for a long time, but if the battery becomes partly exhausted or if more lamps are switched on the gasoline engine starts automatically and lights the lamps direct from the generator and at the same time recharges the battery. As the lamps are switched off the engine stops itself, and the remaining lights are supplied by the battery until they are switched off.

All the work necessary in keeping the apparatus in running condition consists of filling a gasoline tank, filling a lubricating oil reservoir from which the running parts are oiled by means of a pump, and keeping the plant clean. No other attention is required, and a few minutes time is all that is necessary to meet the simple requirements as they arise. The designs are in various sizes ranging from 50 to 2,000 lamps and include 15 different varieties in size, all of the same, simple construction and occupying spaces ranging from 9 feet by 6 feet, to 17 feet by 14 feet, and weighing without the battery from 1,230 pounds to 10,000 pounds. The prices, of course, vary according to the size of the machines but the general results after installation in point of economy have been carefully [illegible] lighting by the Bruston system and that of natural gas at 30 cents per 1,000 cubic feet, the reduction amounts to 75 per cent.

Railroad men are already interested in the system and there are indications that extensive installations will be made in the near future in the smaller stations, roundhouses, and other points that may be removed considerable distances from the larger division points where electric lighting systems of a larger kind are already in service. As may be imagined the appliance may be readily removed from place to place, and would be readily adaptable to structural work where changing locations are constantly necessary, and in every conceivable situation where the electric mains do not penetrate, and where oil lamps or some of the expensive and dangerous gas generating systems may have been experimented with the Bruston system provides electricity for light, power and all other purposes, and is at once reliable in operation, durable in wear and inexpensive in maintenance.

It may be added that the system has already obtained the highest possible awards at all the leading exhibitions in Great Britain and its introduction in America is already in progress, and to meet the growing demands of orders of many leading hotels and other establishments; offices of the Bruston Electric Lighting and Power Company have been established at 126 Liberty street, New York.



It [illegible] be added that electric light [illegible] Bruston automatic plant requires less attention than acetylene or gasoline light. It does not vitiate the air or give off poisonous fumes, consequently it is much healthier. There is no smoke, and it does not, therefore, spoil decorations.

Items of Personal Interest

[illegible] general foreman of the National Transcontinental with office at Transcona, Man.

[illegible]

Mr. Walter Shelton has been appointed [illegible] of the Chesapeake & Ohio, with office at Silver Grove, Ky., succeeding Mr. David Evans, promoted.

Mr. W. L. Hazzard has been appointed supervisor of piece work of motion power department of the New York Central, with office at Grand Central Terminal, New York.

Mr. R. A. Billingham has been appointed mechanical superintendent of the Tennessee Central, with offices at Nashville, Tenn. The office of master mechanic has been abolished.

Mr. [illegible] has been appointed [illegible] Pennsylvania Steel Company, with offices at New York. Mr. Belknap was for several years the company's sales manager at Chicago, Ill.

Mr. J. W. Baum,, formerly general foreman of the Lake Erie, Franklin & Clarion, at Clarion, Pa., has been appointed master mechanic at that place, and the office of general foreman has been abolished.

Mr. R. M. Kincaid, formerly valuation engineer of maintenance of equipment of the Chicago & Eastern Illinois, has been appointed master mechanic of the Illinois & St. Louis divisions, with office at Villa Grove, Ill.

Mr. H. A. Varney has resigned as general sales manager of the National Boiler Washing Company, Chicago, to become manager of the railroad department of the Smith-Totam Company, Gas Building, Chicago.

Mr. W. L. Kinsell formerly chief clerk to assistant to Vice-President David van [illegible] & Hartford, has been appointed assistant shop superintendent at the company's shops at Readville, Mass.

Mr. I. L. Taylor Jr., formerly assistant division engineer of the Erie and Ashtabula divisions of the Pennsylvania Lines West of Pittsburgh, has been transferred to the Pittsburgh division of the same road, with office at Pittsburgh, Pa.

Mr. Duncan Campbell, for several years superintendent of construction for the Canadian Northern, has been appointed superintendent and assistant general manager of the Canadian Northern, between Edmonton and Vancouver.

Mr. W. Homult, formerly [illegible] inspector of the Chicago & North Western has been appointed assistant signal supervisor of the Chicago terminal, succeeding Mr. E. E. Schultz who has been transferred to the office of the signal engineer.

Mr. H. Darby has been appointed locomotive foreman of the Grand Trunk Pacific, with office at Biggar, Sask., succeeding Mr. A. McTavish who has been appointed locomotive inspector at the Transcona shops at the National Transcontinental.

Mr. Leigh M. Borden has been appointed master carpenter on the Rochester division of the Erie. He was formerly employed as foreman carpenter on the Tioga division of the same road at Blosburg, Pa. This service on the road extends over twenty years.

Mr. H. W. Andrew, formerly coach yard foreman of the Canadian Northern at Winnipeg, Man., has been appointed general car foreman at the same place succeeding Mr. A. McCowan, who has been appointed supervisor of car works on the Canadian, Northern with offices at Winnipeg.

Mr. Andrew A. Allen, formerly president of the Missouri, Kansas & Texas, is reported, as acting director of traffic for the allied powers in the western theater of the European war. Mr. Allen is attached to the personal staff of Lord Kitchener with offices in London, but is said to have passed much of his time in [illegible]

Mr. W. J. Ahern has been appointed general foreman on the Chesapeake & Ohio, with office at Newport News, Va., succeeding Mr. I. W. Foizey. Mr. Ahern entered the company's service in 1903, and has filled various positions in the mechanical department, including assistant general foreman and roundhouse foreman.

Mr. D. Chase has been appointed general foreman on the Missouri, Kansas & Texas Lines, with office at Greenville, Tex., succeeding Mr. J. L. Miller resigned, and B. W. Webb has been appointed roundhouse foreman at Greenville, succeeding Mr. S. W. Parks, who was appointed general foreman at Woodward, succeeding Mr. M. P. Jones, resigned.

Mr. I. W. Foizey, who has been appointed assistant master mechanic of the Chesapeake & Ohio, with office at Newport News, Va., began his railway career as a machinists's apprentice on the same road in 1875. In 1891 he was general foreman at Newport News, and in 1902 he was transferred to a similar position at Clifton Forge, Va., and returned to Newport News in 1914.

Mr. Paul M. Lincoln, whose term as president of the American Institute of Electrical Engineers, expired July 1, 1915, and who has for a number of years been prominently identified with the Westinghouse Electric & Mfg. Company's Engineering Department, has resigned his position with this company in order to devote his time to the manufacture of a meter which he has recently invented.

Mr. C. F. Gailor, formerly assistant chief engineer of the United Railways & Electric Company, of Baltimore, Md., has resigned to become chief engineer of the Atlantic Welding Corporation, 30 Church street, New York City. In taking up his new duties Mr. Gailor will direct the manufacture and installation of the welded rail joints manufactured by this company, with which he has been intimately connected for several years, having been the original inventor of this joint.

Mr. George A. Blackmore has recently been appointed by the Union Switch and Signal Company general sales manager in charge of the activities of the New York, Montreal and Atlanta offices, with headquarters at New York. Resident Managers Mr. A. Dean, of New York; Mr. T. H. Patenall, of Montreal; and Sales Engineer Brastow, of Atlanta, and located in Swissvale in charge of sales, construction and commercial engineering.

The Westinghouse Electric & Mfg. Company announces a number of changes in the Supply Department, which have been put into effect recently, among which are the following:

Mr. G. P. MacLaren has been appointed division engineer of the Toronto district of the Canadian Northern, with office at Toronto, Ont.; Mr. A. J. Gayfer has been appointed division engineer of the Lake Superior district with office at Capreol, Ont.; Mr. J. D. Evans, division engineer at Trenton, Ont., has been appointed supervisor of bridges and buildings, with office at Trenton; Mr. F. McKay, supervisor of bridges and buildings at Toronto, has been appointed supervisor of bridges and buildings, with office at Capreol, Ont.

Mr. C. E. Stephens, Engineer of Lighting has been appointed manager of the illuminating section to succeed Mr. Pace. Mr. C. Streamer, formerly head of the Order Division succeeds Mr. Schluederberg as manager of the Switchboard Section, and Mr. A. P. Joseph is appointed head of the Order Section to succeed Mr. Streamer. Mr. M. G. Morrow, formerly of the Philadelphia office, is appointed manager of the Appliance Section, which is a combination of the former Heating, Fan Motor and Ozoniser Divisions of the Supply Department. Mr. M. C. Rypinski, formerly manager of the D. & S. Division of the New York office, becomes manager of the Meter Section.

Mr. J. F. Murphy formerly superinten-

dent of the Missouri Pacific-Iron Mountain has been appointed general manager of the same road. Mr. Murphy began his railroad career as a yard clerk in 1887 on the Peoria & Pekin Union, graduating to brakeman and switchman and yard master on several of the western roads. From 1902 to 1905 he was superintendent of the terminal Kansas City Southern. From 1905 to 1907 he was trainmaster on the Missouri Pacific and from 1907 to 1911 trainmaster on the same road, since which time he has been connected with the Pacific-Iron Mountain. Mr. Murphy is still a comparatively young man being in his forty-fifth year.

OBITUARY.

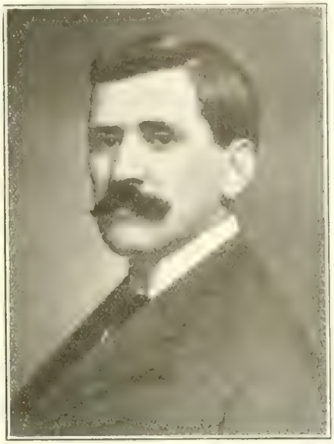
W. F. Allen.

A figure very prominent for years in railway organizations, has passed away in the death of William Frederick Allen, secretary of the American Railway Association, who died at his home in South Orange, N. J., on November 9, in the sixty-ninth year of his age. Mr. Allen was born at Bordentown, N. J., and entered railway life in the engineering corps of the Camden & Amboy, which was the first part of the great Pennsylvania Railroad system. He [illegible] the engineering department of the Pennsylvania Railroad up to 1872, when he entered the service of the National Railway Publishing Company and shortly afterwards was made assistant editor of the *Official Railway Guide*. One year later he was made editor and manager of the *Guide* and has held the position ever since. In 1910 he was elected vice-president of the National Railway Publishing Company, and four years later was elected president of the company. His well-known business capacity brought to Mr. Allen a variety of [illegible] One of his greatest achievements was working out the problem of standard time. On that account he is known as the "father of standard time."

WILLIAM F. ALLEN.

James F. De Voy.

The railway mechanical world has lost a remarkable [illegible] member in the death of James F. De Voy, assistant superintendent of motive power of the Chicago, Milwaukee & St. Paul, which happened on November 5. Mr. De Voy was one of the most energetic members of various railway mechanical organizations; he was a past president of the Western Railway Club, and was on a fair way to become president of the American Railway Master Mechanics' Association, having been a member of the executivee committee. Mr. De Voy was a graduate of Cornell University, and entered railway life on the New York Central Railroad. Fifteen years ago he went to the Chicago, Milwaukee & St. Paul as chief draftsman, from which position he rose by sheer force of merit to be assistant superintendent of motive power. For the last eight months he suffered from a most painful malady, which finally closed his career.



JAMES F. DE VOY.

Joseph G. Hendrickson.

The death is [illegible] Joseph G. Hendrickson, the founder of the Ajax Metal Company, which was established in 1880. He retired as president of the company [illegible] since then has been chairman of the board, also chairman of the board of directors of the Ajax Metal Company of the South, Birmingham, Ala., and president of the Ajax Lead Coating Company. He was very highly esteemed by all with whom he came in contact, and was a leading member of [illegible] other societies.

Selection of Committees and Subjects to Be Reported on at the Master Car Builders' Association in 1916.

1. Arbitration: J. J. Hennessey (chairman), M. C. B., C. M. & St. P. Ry., Milwaukee, Wis.; T. W. Demarest, S. M. P., Pennsylvania Lines, Ft. Wayne, Ind.; Jas. Coleman, S. C. D., Grand Trunk Ry.; Montreal, Can.; F. W. Brazier, S. R. S., N. Y. C. R. R., New York City; T. H. Goodnow, A. S. C. D., C. & N. W. Ry., Chicago, Ill.

2. Standards and Recommended Practice: T. H. Goodnow (chairman), A. S. C. D., C. & N. W. Ry., Chicago, Ill.; W. H. V. Rosing, asst. to v.-p., St. L. & S. F. R. R., Springfield, Mo.; C. E. Fuller, S. M. P., Union Pacific R. R., Omaha, Neb.; A. R. Ayers, C. M. E., N. Y. C. R. R., New York City; O. C. Cromwell, M. E., Baltimore & Ohio R. R., Baltimore, Md.; O. J. Parks, German-American Car Lines, Chicago, Ill.; R. E. Smith, G. S. M. P., Atlantic Coast Line R. R., Wilmington, N. C.

3. Train Brake and Signal Equipment: R. B. Kendig (chairman), G. M. E., N. Y. C. R. R., New York City; B. P. Flory, S. M. P., N. Y. O. & W. R. R., Middletown, N. Y.; J. M. Henry, S. M. P., Pennsylvania R. R., Pittsburgh, Pa.; L. P. Streeter, air brake engr., Ill. Cent. R. R., Chicago, Ill.; R. B. Rasbridge, C. C. I., Philadelphia & Reading Ry., Reading, Pa.; W. J. Hartman, air brake inst., C. R. I. & P. Ry., Chicago, Ill.; A. J. Cota, M. M., C. B. & Q. R. R., Chicago, Ill.

4. Brake Shoe and Brake Beam Equipment: Prof. Chas. H. Benjamin (chairman), Purdue University, Lafayette, Ind.; C. D. Young, eng. tests, Pennsylvania R. R., Altoona, Pa.; R. B. Kendig, G. M. E., N. Y. C. R. R., New York City; J. F. DeVoy, A. S. M. P., C. M. & St. P. Ry., W. Milwaukee, Wis.; C. B. Young, M. E., C. B. & Q. R. R., Chicago, Ill.

5. Couplers: R. L. Kleine (chairman), C. C. I., Pensylvania R. R., Altoona, Pa.; G. W. Wildin, M. S., N. Y. N. H. & H. R. R., New Haven, Conn.; F. W. Brazier, S. R. S., N. Y. C. R. R., New York City; F. H. Stark, supt. R. S., Montour R. R. Co., Coraopolis, Pa.; J. F. DeVoy, A. S. M. P., C. M. & St. P. Ry., W. Milwaukee, Wis.; J. W. Small, S. M. P., S. A. L. Ry., Portsmouth, Va.; J. A. Pilcher, M. E., N. & W. Ry., Roanoke, Va.

6. Loading Rules: A. Kearney (chairman), A. S. M. P., N. & W. Ry., Roanoke, Va.; A. B. Corwith, G. C. I., A. C. L. R. R., Wilmington, N. C.; L. H. Turner, S. M. P., P. & L. E. R. R., Pittsburgh, Pa.; R. L. Kleine, C. C. I., Pennsylvania R. R., Altoona, Pa.; J. M. Bor- [illegible] R. R.,

Chicago, Ill.; C. N. Swanson, S. C. S., A. T. & S. F. Ry., Topeka, Kan.; H. C. May, S. M. P., C. I. & L. Ry., Lafayette, Ind.

7. Car Wheels: W. C. A. Henry (chairman), S. M. P., Pennsylvania Lines, Columbus, Ohio; A. E. Manchester, S. M. P., C. M. & St. P. Ry., Milwaukee, Wis.; L. C. Ord, G. C. I., Can. Pac. Ry., Montreal, Can.; J. A. Pilcher, M. E., N. & W. Ry., Roanoke, Va.; O. C. Cromwell, M. E., B. & O. R. R., Baltimore, Md.; J. M. Shackford, C. D., D. L. & W. R. R., Scranton, Pa.; H. E. Smith, eng. tests, N. Y. C. R. R., Collinwood, Ohio.

8. Safety Appliances: D. R. MacBain (chairman), S. M. P., N. Y. C. R. R., Cleveland, Ohio; D. F. Crawford, G. S. M. P., Pennsylvania Lines West, Pittsburgh, Pa.; C. E. Fuller, S. M. P., Union Pac. Ry., Omaha, Neb.; C. B. Young, M. E., C. B. & Q. R. R., Chicago, Ill.; H. Bartlett, G. S. M. P., B. & M. R. R., Boston, Mass.; S. G. Thomson, S. M. P. & R. E., P. & R. R. R., Reading, Pa.; E. A. Sweeley, M. C. B., S. A. L. Ry., Portsmouth, Va.

9. Car Construction: W. F. Keisel, Jr. (chairman), A. M. E., Pennsylvania R. R., Altoona, Pa.; A. R. Ayers, G. M. E., N. Y. Central R. R., New York City; S. G. Thomson, S. M. P. & R. E., Phila. & Reading R. R., Reading, Pa.; C. E. Fuller, S. M. P., Union Pacific R. R., Omaha, Neb.; E. G. Chenowith, M. E., C. R. I. & P. Ry., Chicago, Ill.; J. C. Fritts, M. C. B., D. L. & W. R. R., Scranton, Pa.; C. L. Meister, M. E., Atlantic Coast Line R. R., Wilmington, N. C.

10. Specifications and Tests for Materials: C. D. Young (chairman), engr. tests, Pennsylvania R. R., Altoona, Pa.; J. R. Onderdonk, engr. tests, Baltimore & Ohio R. R., Baltimore, Md.; J. J. Birch, D. C. I., Norfolk & Western Ry., Roanoke, Va.; I. S. Downing, G. M. C. B., C. C. C. & St. L. Ry., Indianapolis, Ind.; Frank Zeleny, engr. tests, C. B. & Q. R. R., Aurora, Ill.; A. Copony, M. C. B., Grand Trunk Ry., Chicago, Ill.; A. H. Fetters, M. E., Union Pacific Ry., Omaha, Neb.; H. B. MacFarland, engr. tests, A. T. & S. F. Ry., Chicago, Ill.; G. S. Sprowle, S. M. P., A. C. L. R. R., Rocky Mount, N. C.

11. Car Trucks: J. T. Wallis (chairman), G. S. M. P., Pennsylvania R. R., Altoona, Pa.; E. W. Pratt, A. S. M. P., C. & N. W. Ry., Chicago, Ill.; Jas. Coleman, S. C. D., Grand Trunk Ry., Montreal, Can.; J. J. Tatum, S. F. C. D., B. & O. R. R., Baltimore, Md.; Prof. E. C. Schmidt, University of Illinois, Urbana, Ill.; L. C. Ord, G. C. I., Can. Pac. Ry., Montreal, Can.; J. McMullen, M. S., [illegible] Meadville, Pa.; [illegible] M. E., N. Y. C. R. R., [illegible] City; E. G. Chenowith, M. E., C. R. I. & P. Ry., Chicago, Ill.

12. Prices for Labor and Material: P. F. Smith, Jr. (chairman), S. M. P., Pennsylvania Lines, Toledo, Ohio; G. E. Carson, D. M. C. B., N. Y. C. R. R., W. Albany, N. Y.; W. L. Kellogg, S. M. P., M. K. & T. Ry., Denison, Tex.; J. E. Mehan, A. M. C. B., C. M. & St. P. Ry., W. Milwaukee, Wis.; Ira Everett, G. C. I., L. V. R. R. So. Bethlehem, Pa.; Willard Kells, A. G. S. M. P., A. C. L. R. R., Wilmington, N. C.; O. J. Parks, German-American Car Lines, Chicago, Ill.; H. L. Osman, Morris & Co., Chicago, Ill.; G. F. Laughlin, Armour & Co., Chicago, Ill.; Thos. Beaghen, Jr., Union Tank Line, New York City.

13. Train Lighting and Equipment: J. H. Davis (chairman), elec. engr., B. & O. R. R., Baltimore, Md.; Ward Barnum, elec. engr., L. & N. R. R., Louisville, Ky.; C. H. Quinn, A. E. M. P., N. & W. Ry., Roanoke, Va.; D. J. Cartwright, elec. engr., Lehigh Valley R. R., So. Bethlehem, Pa.; E. W. Jansen, elec. engr., Illinois Central R. R., Chicago, Ill.; H. C. Meloy, elec. engr., N. Y. C. R. R., Cleveland, Ohio; J. R. Sloane, engr. elec. car lighting, Pennsylvania R. R., Altoona, Pa.

14. Nominations: F. W. Brazier (chairman), S. R. S., N. Y. C. R. R., New York City; [illegible], Pennsylvania R. R., Philadelphia, Pa.; F. H. Clark, G. S. M. P., B. & O. R. R., Baltimore, Md.; [illegible], Cent. of Ga. Ry., Savannah, Ga.; J. J. Hennessey, M. C. B., C. M. & St. P. Ry., W. Milwaukee, Wis.

15. [illegible]

16. [illegible] G. M. S., Erie R. R., New York City; C. A. Shoemaker, German-American Car [illegible]

17. [illegible] Wooden Cars: J. McMullen (chairman), M. S., Erie R. R., Meadville, Pa.; T. J. Burns, M. C. B., Mich. Cent. Ry., Detroit, Mich.; J. E. Mehan, Asst. to M. C. B., C. M. & St. P. Ry., W. Milwaukee, Wis.; H. H. Harvey, G. C. I., C. B. & Q. R. R., Chicago, Ill.; C. N. Swanson, S. C. S., A. T. & S. F. Ry., Topeka, Kan.; C. E. Fuller, S. M. P., Union Pacific R. R., Omaha, Neb.; T. W. Demarest, S. M. P., Pennsylvania Lines, Ft. Wayne, Ind.

18. Draft Gear: Prof. L. E. Endsley (chairman), University of Pittsburgh, Pittsburgh, Pa.; W. E. Dunham, Supt. M. P. & M., C. & N. W. Ry., Winona, Minn.; J. R. Onderdonk, engr. tests, B. & O. R. R., Baltimore, Md.; A. R. Kipp, M. E., Soo Line, Fond du Lac, Wis.; G. W. Rink, M. E., C. R. R. of N. J., Jersey City, N. J.; P. F. Smith, Jr., S. M. P., Pennsylvania Lines, Toledo, Ohio; J. C. Fritts, M. C. B., D. L. & W. R. R., Scranton, Pa.

19. Welding of Truck Side Frames and Bolsters: W. O. Thompson (chairman), S. R. S., N. Y. C. R. R., Buffalo, N. Y.; G. W. Rink, M. E., C. R. R. of N. J., Jersey City, N. J.; J. T. Wallis, G. S. M. P., Pennsylvania R. R., Altoona, Pa.; J. J. Hennessey, M. C. B., C. M. & St. P. Ry., W. Milwaukee, Wis.; A. M. McGill, A. S. M. P., L. V. R. R., So. Bethlehem, Pa.

Piston Rings.

Prof. John E. Sweet, the eminent engineer, president of a Syracuse engineering company engaged in the manufacture of High Speed Automatic Horizontal engines, commenting on an article on pistons that appeared on page 379 of the November issue of RAILWAY AND LOCOMOTIVE ENGINEERING, states in an excellent letter that if all engines were made as hundreds are now being made with the shoulder between the counterbore and cylinder beveled so that the ring can slide up, the breaking of piston rings by dropping in the counterbore would be avoided. Not only so, but with this feature in construction, no trouble is experienced in entering the piston when erecting or repairing the engine.—A word from the wise is enough, and we may add that there is no better authority on the details of the steam engine in America than the [illegible] Mr. Sweet.

Peat as a Fuel for Boilers.

[illegible] of coal in the Netherlands [illegible] the war began has induced inquiries [illegible] all directions for relief by the use of [illegible]stitutes of various kinds. According [illegible] estimates the peat moors of the Netherlands contain over 125,000,000 tons of [illegible]dy-to-burn peat, which is equivalent to [illegible]out 75,000,000 tons of the best coal, and this fuel is immediately available. The [illegible] of the peat fuel is about $4.50 per ton, while the imported English coal is [illegible]50 per ton.

A Select Congregation.

Mr. Ward, the new curate, preached a sermon that shocked some of his people. "My dear Mr. Ward," said the rector, "you must try to remember that our people here are nice people—good people, in fact—and in the future you must endeavor to—er—er—qualify things a little." The curate finished up his next sermon somewhat after this fashion—"And so, my dear brethren, you will have to repent, as it were, and to reform, so to [illegible] you will be damned—to some extent."

Discovered Over Fifty Years Ago

That the use of flake graphite combined with silica made the most ideal pigment for protective paint that has ever been produced. And its use for over fifty years has proven that

DIXON'S SILICA GRAPHITE PAINT

has no equal as a protective paint for steel, iron and wood. It retains its original toughness and elasticity for almost indefinite periods. Dixon's Silica-Graphite Paint has been used on many structures all over the world. "There's a reason." Write for booklet No. 69-B, to the

Joseph Dixon Crucible Company

Jersey City, New Jersey

Established 1827

RAILROAD NOTES.

The Union Pacific has ordered 50,000 tons of rails from the Illinois Steel Company.

The Erie has ordered 13 all-steel sub-[illegible] Car Company.

The Norfolk & Western Railway has ordered 12,000 tons of rails from the Carnegie Steel Company.

The Great Northern Railway has ordered 8 locomotives from the Lima Locomotive Corporation.

The Northern Pacific has ordered 1,000 center constructions from the Western Steel Car & Foundry Company.

The Chicago & Alton has ordered 150 composite gondola car bodies from the Haskell & Barker Car Company.

The Chicago, St. Paul, Minneapolis & Omaha has ordered 10,000 tons of rails from the Lackawanna Steel Company.

The Minneapolis, St. Paul & Sault Ste. Marie has ordered 200 steel ore cars from the American Car & Foundry Company.

The Des Moines Union Railway has ordered two six-wheel (0-6-0) switching locomotives from the Baldwin Locomotive Works.

The Western Maryland has ordered 1,000 steel hopper cars from the Pullman Company. These are in addition to 2,000 [illegible]

The Northern Pacific has ordered 20,000 tons of rails from the Illinois Steel Company, Lackawanna Steel Company and the Bethlehem Steel Company.

The Delaware, Lackawanna & Western has ordered two dining cars from the Pullman Company and 500 hopper cars from the American Car & Foundry Company.

The Gulf Colorado & Santa Fe will erect a shop building, 70 by 140 feet, at Cleburne, Texas, and is reported as planning other improvements at Cleburne.

The Imperial Government Railways of Japan have given the Hall Switch & Signal Company an order for 42 two-arm signals with necessary relays, lightning arresters, etc.

The New York, Chicago & St. Louis has ordered 600 center constructions from the Pressed Steel Car Company, and has also given the latter an order to repair 300 hopper cars.

The New York Central has ordered 1,000 55-ton hopper cars from Standard Steel Company. These cars, which are in addition to previous orders reported, are for the Pittsburgh & Lake Erie.

The French government has ordered 1,000 four-wheel box cars from the Standard Steel Car Company. These will be built at the plant of the Keith Car & Manufacturing Company, Sagamore, Mass.

The Boston & Albany has placed an order with the American Locomotive Company for 4 Mallet (2-6-6-2) locomotives. The cylinders will be 22½ and 34 by 32 inches, driving wheels 57 inches, total weight in working order 354,000 pounds.

The Missouri, Kansas & Texas has ordered 5 superheater Pacific type locomotives from the American Locomotive Company. These locomotives will have 25 by 28 in. cylinders, 73 in. driving wheels, and a total weight in working order of 272,000 pounds.

The Chicago & North Western has ordered 30,000 tons of rails from the Illinois Steel Company and 1,000 tons from the Cambria Steel Company. This is the total order placed for next year's requirements and includes the order for 15,000 tons reported previously.

The New York, New Haven & Hartford has awarded the American Locomotive Company an order for 33 locomotives. Eight of these are Mikado (2-8-2) type engines with cylinders 26 by 32 inches, driving wheels 63 inches, total weight in working order 325,000 pounds, and 25 are Mikados with cylinders 25 by 30 inches, driving wheels 63 inches, total weight 260,000 pounds.

The Pennsylvania Lines West has ordered 48 superheater Consolidation locomotives from the American Locomotive Company and 15 of the same type from the Lima Locomotive Corporation. Of these 63 locomotives, 50 will be used by the Pennsylvania Company, 10 by the Vandalia and 3 by the Grand Rapids & Indiana. The locomotives ordered from the American Locomotive Company will have 26 by 28-in. cylinders, 62-in. driving wheels and a total weight in working order of 253,000 lbs. each. The report in the issue of November 12 that the Pennsylvania Lines West had ordered 53 locomotives from the Lima Locomotive Corporation and 10 from the American Locomotive Company was incorrect.

Awards to Armstrong Bros. Tool Co.

Armstrong Bros. Tool Co., Chicago, [illegible] Grand Prize for Tool Holders at the Panama-Pacific Exposition at San Francisco, this being the first Grand Prize ever awarded for an exhibit of Tool Holders at any International Exposition, and the only Grand Prize awarded exclusively and specifically to an exhibit of Tool Holders independently of other products. They were also awarded a Medal of Honor on other Armstrong products exhibited including Ratchets, Drop Forged Wrenches, Clamps, Lathe Dogs, etc.

Mechanical Engineers' Meeting.

At the annual meeting of the American Society of Mechanical Engineers, to be held in the Engineering Building, 39th street, between 5th and 6th avenues, New York, December 7 to 10, there will be a session devoted to railroad subjects. This session is under the direction of the Sub-committee on railroads of this society. The papers to be presented are as follows: Operation of Parallel and Radial axles of a locomotive by a single set of cylinders, by Anatole Mallet, M. E. Four-Wheel tracks for Passenger cars, by Roy W. Wright, M. E. Both subjects are of importance to railroad men and a large meeting may be expected. The railroad session will occur on Wednesday afternoon, December 8.

Hot Regions.

[illegible] Mexico where some covered surfaces hold heat like active ovens, are noted for the high temperatures that prevail during certain parts of the year. It was in one of these regions that Mark Twain told about a native who died and went to hell but wanted permission to return for his blankets.

Arizona is hot but it hardly comes up to the temperature of some places in Asia and Africa. The Aval Islands cover a fairly extensive area of the Persian Gulf, lying off the southwest coast of Persia and it is the largest of them which enjoys the doubtful distinction of leading all perspiring com- [illegible] mean temperature of Bahrein for the entire year is 99 degrees. July, August and September are unendurable save [illegible] midnight comes, the thermometer shows 100. By 7 in the morning it is 107 or 108 degrees, and by 3 in the afternoon 140. It is stated by veracious travelers that 75,000 Arabs inhabit the Aval group, fully 25,000 living on Bahrein, in which connection Sir Henry [illegible] thing." The following are the temperatures at some of the hottest places in different countries. Hydersbad, 105 degrees; Lahore, 107 degrees; El Paso, 113 degrees; Mosul, 117 degrees; Agra, 117 degrees; Death Valley, 122 degrees; Algeria, 127 degrees; Fort Yuma, 128 degrees; Jacobobad, 122 degrees; Bahrein, 140 degrees.

Wonders of Arizona.

When we had decided to visit the Pan- [illegible] Exposition, we made up our minds to visit the Grand Cañon of Arizona, but circumstances intervened that made the visit impossible at this time. Still we console ourselves that there is a good time coming. A cherished ambition that clings to our inner consciousness is to stop off at Flagstaff some day and begin exploring the wonders of Arizona. The *Santa Fé Magazine* informs us that ten miles out are the prehistoric cliff dwellings, a region that was peopled by civilized people when Abraham was a boy. The ice caves and lava beds are only sixteen miles distant, and the petrified forest and painted desert are near by. The extinct volcanoes are only eighteen miles out; Montezuma's Well, fifty miles; Indian snake dance, about one hundred miles; prehistoric ruins, twenty-five miles; natural bridge, seventy-five miles, and the great San Francisco peaks, towering 12,900 feet, twelve miles; Lake Mary, ten miles.

Cleaning.

[illegible] the use of oxalic acid or buttermilk. Rust may be cleaned from iron by kerosine oil. Paint on glass may be removed by the use of strong hot vinegar, the same may be used on smoked mica. Dry putty may [illegible] a pint of water will clean brass. Unslaked lime will clean steel, common whit- [illegible] in vinegar will prevent a lamp from smoking.

Addressing a School.

Upton Sinclair tells this story about a [illegible] school of little boys," said Mr. Sinclair, "and I opened my address by laying a coin upon the table. 'I am going to talk to you boys about Socialism,' I said; 'and when I finish, the boy who gives me the best reason for turning Socialist will get this money.' Then I spoke for some twenty minutes. The boys were all converted at the end. I began to question them. 'You are a Socialist?' I said to the boy nearest me. 'Yes, sir,' he replied. 'And why are you a Socialist?' I asked. He pointed to the coin. 'Because I need the money,' he said."

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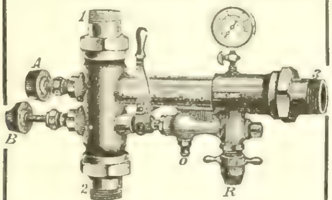

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The Testing of Machine Tools.

[illegible] are the American selling agents of a new [illegible] Burley, a well-known engineering author- [illegible] with 110 illustrations, price, $1.50. The clear style and wide experience of the talented author is shown in every page and the book is suitable for engineer apprentices and students as well as responsible engineers. With the increasing demands for accuracy and efficiency the subject is of prime importance. The book is not a mere republication of the results of tests but is rather an interesting description of methods and instruments that are adapted to the making of tests. The testing of cutting tools has also a chapter near the end of the book. The work as a whole may be fairly considered as a remarkably successful effort in the directing of gauging accurately the possible output of machine tools and the degree of exactitude with which the work may be accomplished and to these ends a large variety of instruments apparently of original designs are furnished, all of which are of merit.

Railway Regulation.

The La Salle Extension University, Chicago, has issued a work on Railway Regulation by Prof. I. Leo Sharfman, 236 pages, flexible leather binding, price, $2. The book is divided into ten chapters, among which the more important are: The Theory and Practice of Rate Making [illegible] Between State and Federal Authority—Federal Regulation. The whole series of subjects in relation to railways is treated in a masterly way, and no student of economics, as far as railway regulation is concerned, can afford to overlook this brilliant summing up of the situation in America. It is altogether a particularly able and intelligent review of a vast experiment in American governmental activity. Lawyers, politicians, and statesmen, if there be any, will read it with special interest. Probably railroad men and shippers will find the most profit from a close perusal of its pages, because the book goes to the very foundation of a matter with which they are vitally concerned.

Proceedings of the International Railway General Foremen's Assn.

Mr. William Hall, secretary of the Rail- [illegible] proceedings of the Eleventh Convention of the Association held at the Hotel Sherman, Chicago, last July, and it forms a [illegible] than the review of the subjects discussed at the last convention. Among the most [illegible] and Valve Gearing received the most attention, nearly 100 pages of the proceedings being devoted to the subject. Every detail in regard to the various kinds of valve gearing now in use in locomotives was presented and discussed with a degree of fulness from which nothing escaped, so that this feature alone stamps the publication as the high water mark in locomotive valve gears. Rods, tires and wheels were also discussed with marked ability. Shop and Roundhouse Efficiency received serious and profitable attention. The same may be said of a subsidiary paper on the subject of Oxy-Acetylene Welding. The subjects are profusely illustrated and include a collection of fine portraits of the officers.

Railway Mail Pay.

That railroad revenues as a whole are insufficient and should be increased is the unanimous verdict of everybody that knows anything about railroads, but we doubt if the subject has ever been discussed as intelligently as has been done by the Merchants' Association of New York, and a report of their proceedings especially in regard to Railway Mail Pay now appears in pamphlet form. To say that it is convincing is putting it mildly. It is an arraignment of the government that is unanswerable. The report not only clearly condemns the past actions of the Federal government, but with the eye of prescience the future is laid bare, and the Association boldly sets forth that the plan of space-payment for mail-carriage proposed by the Bourne and the Moon Bills is excessively discriminatory in favor of the United States Government, in that it makes, for mail-freight, carried on passenger trains, a rate only about one-third to one-half the rate paid for high-grade freight carried on freight [illegible] tities of high-grade merchandise, on all of which the railroads will suffer a loss of one-half to two-thirds of their present freight revenues; and, therefore, that the Merchants' Association of New York oppose any and all bills for the re-adjustment of railway mail pay on the basis [illegible] posed by the Bourne and the Moon Bills.

How Can [illegible] Be Strengthened?

Mr. A. J. County, special assistant to the president of the Pennsylvania Railroad Company, delivered an excellent address at the University of Philadelphia, last month, and it now appears in pamph-

Federal and State bills affecting the rail-

hundred and forty enacted, whether ar-
bitrary or wasteful seemed to make little

pear devoid of benefit to the public and
the railroads which together pay the out-

This is going some, and the end is not
yet.

Car Door Fasteners.

pany has just issued circular No. 54, de-
scriptive of car door fasteners, handles,

company, and it is interesting to observe
the marked improvement in the numer-
ous details presented, not to speak of the
lightness of the castings that effectually

owing to the improved quality of the re-

the same time a strength and durability
hitherto unattained in the smaller arti-

equipment. Apart from these qualities
the variety of fasteners, brackets, hang-
ers and guides are all of real artistic de-

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as much as genuine babbitt, has greater
resistance than the pure article. In brief,

ing bearing metals until the laws of fric-

use it, which is the best proof of its en

First Aid to the Injured on the Baltimore and Ohio.

and effective methods of administering
emergency treatment following accidents
has been issued by Dr. Joseph F. Tear-
ney, chief medical examiner of the Balti-
more and Ohio Railroad, for distribution
to the working forces of the company.
The booklet will be valuable to keep in

sickness, explaining the proper emergency
treatment of fractures, wounds, shocks,
etc., and the best means of setting up
artificial respiration. The booklet is
amply illustrated.

Not Irish Either.

Irish writers and speakers are credited
with using paradoxical expressions, but

blunders.
Thiers wrote: "Throughout the day

that "in the midst of many crumbling in-
stitutions that of property stands erect
on its feet, seated upon Justice." The

his helmet waves a missing plume," is

of M. Toussenel, journalist, naturalist,
historian? He is guilty of this: "The
English and Russian nations, the two
greatest powers in the world, are precisely
those in which the man makes the greatest
efforts to ...

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